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Engineering and Mining Journal

VOLUME 101 MARCH 4, 1916 NUMBER 10

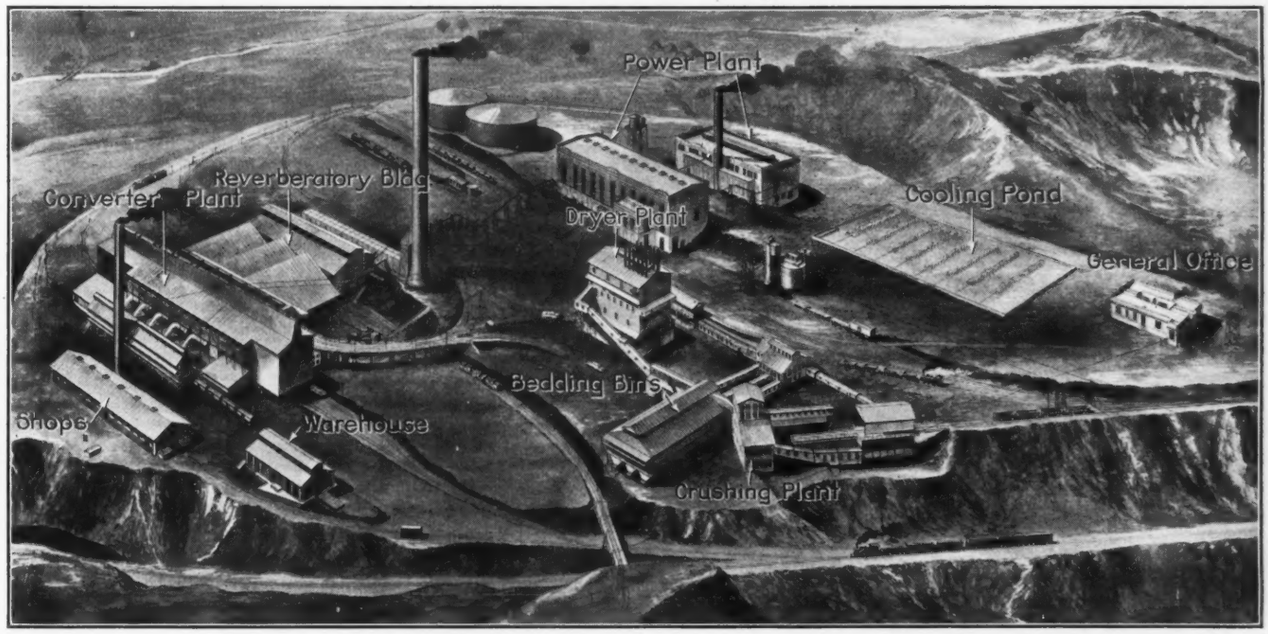
International Smeltery at Miami

By R. W. Kerns*

SYNOPSIS—A new Arizona smelting plant that encountered some unusual problems in smelting a copper charge consisting largely of rich flotation concentrates. No roasting is required; in fact, there is a dearth of sulphur, pyrite ore being imported from Bisbee. Two Cottrell precipitation plants are used, one for the drier plant and one for the converter gases.

The smelting works recently completed by the International Smelting Co., at Miami, Ariz., was designed to treat the concentrates produced by the new Inspiration mill and by the Miami mill. However, the plant is equipped to handle custom ores and offers modern sampling and storage facilities for their accommodation.

It is situated about one mile from Miami and six miles from Globe, on the Inspiration company's branch railroad.



INTERNATIONAL SMELTING PLANT AT MIAMI, ARIZ.

This line connects the Inspiration mill and mine with the Arizona Eastern R.R. at Miami, thus giving the smelting works short rail connections with the two mills and offering facilities for receiving oil fuel, fluxing ores, brick and other supplies.

This is essentially a reverberatory smelting plant. The concentrates from both mills are largely produced by the flotation process and are very fine. When received at the plant, they carry more than 10% moisture and about 40% copper. In this condition they resemble black mud, and their stickiness and extreme fineness were determining factors in the design of the plant.

Special 60-ton steel cars were designed and built to handle these concentrates. The steel body is hopper-shaped throughout its entire length. An opening at the bottom 2 ft. 3 in. wide is covered with creosoted and matched cross-boards. Before the car is loaded, these boards are compressed tightly together by means of a hand-wheel and screw, their alignment being secured by means of steel angle guides on each side. Upon arriving at the smelting works, the cars are run into a steel train-shed over the unloading pocket. A large plug at the back end of the car is drawn out by means of a chain block, leaving a hole through the concentrates through which unloading is begun. The concentrates are raked down on a slope and fall through the slot in the car bottom. Meanwhile, the cross-boards are removed, one after another. Directly beneath the track a hopper guides the material to a belt conveyor that runs to the concentrate-sampling plant. Here a sample is automatically cut out, and the reject is discharged on belts and conveyed to the bedding bins.

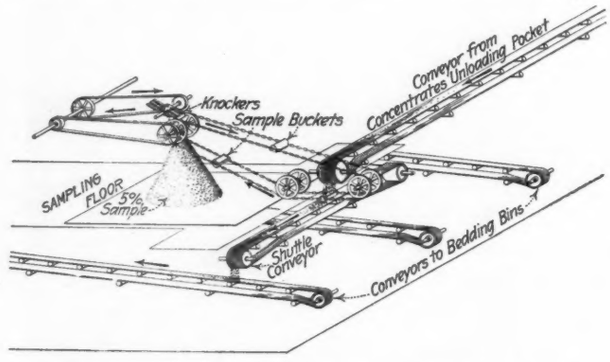
The concentrates sampler consists of a series of buckets, 4 in. wide and 30 in. long, spaced 7 ft. apart and sus-

*With Repath & McGregor, consulting engineers, Warren, Ariz.

pended between sprocket chains. These buckets pass through the stream of concentrates and cut out 5%, which is discharged as the buckets pass over the head sprockets. In order to make a cleaner discharge, the buckets are sharply rapped by short lengths of belt carried on a rapidly revolving shaft. Further reduction of the sample is accomplished by hand quartering, the reject being shoveled through chutes in the floor to the conveyors leading to the bedding bins. Thus far this sampler has not worked well with the flotation concentrates, but does work satisfactorily with the table concentrates.

Lime and pyrite, for fluxing purposes, and custom ores are unloaded from railroad cars into steel receiving bins. A capacity of 1,000 tons is provided in five pockets of 200 tons' capacity each. These V-shaped pockets are self-cleaning and are provided with rack-and-pinion gates that discharge to the traveling steel-apron conveyor feeder. From here a 30-in. belt carries the ore to the Blake crusher. The crushing plant has a maximum capacity of 60 tons per hour. The coarse-crushing room is 22x40 ft. in plan. The ore, after passing over the magnetic head pulley of the conveyor and a wire-cloth grizzly, is crushed to 2½ in. by an 18x30-in. Blake crusher, then to ¾ in. by a set of 54x16-in. rolls, and elevated to the sampling plant.

The steel building that houses the ore-sampling equipment is 30x33 ft. in plan and five stories high. The equipment for fine crushing comprises three 42x16-in.



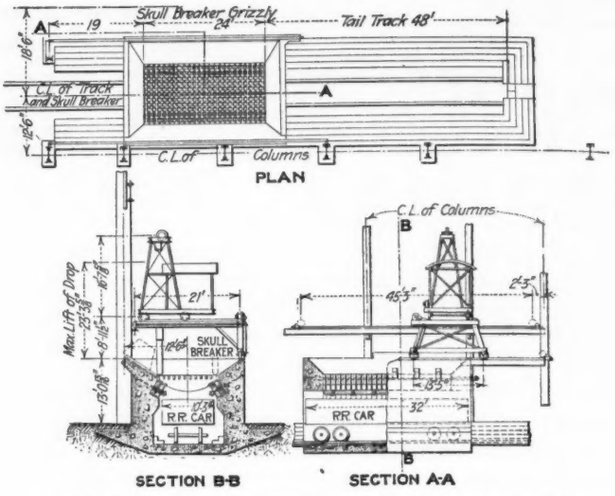
ARRANGEMENT FOR SAMPLING CONCENTRATES

rolls for crushing all reject to $\frac{3}{16}$ in. preparatory to bedding same with the concentrates. The sampling equipment comprises: One 60-in. Snyder sampler, 10% cut; one 27-in. Snyder sampler, 10% cut; two 27-in. Snyder samplers, 20% cut; two 24x8-in. rolls.

Fine Ore and Concentrates Bedded in Bins

The fine ore from the crushing plant is taken by conveyor to bins of the Berquist steel bunker type, which provide storage for 1,200 tons. The three steel bedding bins are shown in cross-section by an accompanying illustration. They provide a combined storage capacity of 9,000 tons of mixed ore and concentrates. They serve a twofold purpose—providing the necessary storage to insure the continuous operation of the furnaces and making possible the intimate mixture of the siliceous concentrates with the fluxing ore, so necessary for the best results in a smelting furnace.

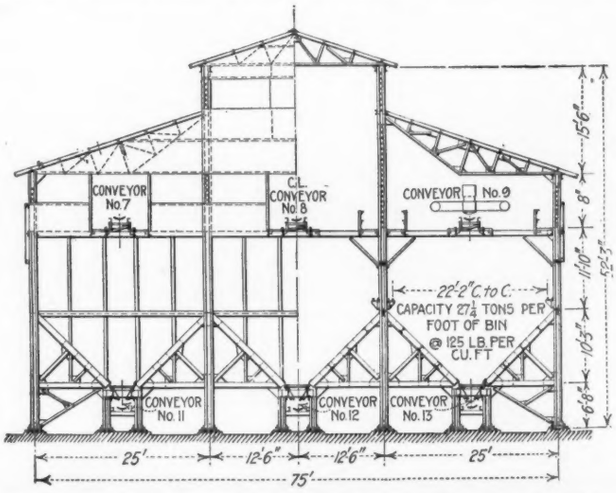
Three specially designed traveling trippers discharge the concentrates from the belts. They travel continuously throughout the length of the bin at a speed of 60 ft. per min., automatically reversing at each end. Two short cross-belts take the place of the ordinary double chute, which would clog with the sticky material. They also provide a wider ore bed than could have been obtained with chutes. These cross-belts, as well as all belts carrying concentrates, are speeded to 400 ft. per min. in order to take advantage of centrifugal force in obtaining a free discharge over the head pulley. A deflector on this tripper is given a reciprocating movement guiding the material first on one and then on the other side of the bin. Two 230-volt 15-hp. direct-current motors furnish separate drives for the cross-belts and the tripper travel.



SKULLBREAKER AT INTERNATIONAL SMELTERY, MIAMI, ARIZ.

The concentrates are reclaimed by hand on three belts running beneath the bins. Like the concentrate cars, these bins are provided with slots at the bottom and cross-planks. The planks are removed one by one, and the material is raked down on its natural slope to the belts beneath.

The moist concentrates, before being fed to the reverberatory furnaces, are conveyed from the bedding bins to the drier plant. The drying is accomplished by means of five Wedge roasting furnaces, 22 ft. 6 in. in diameter, having six hearths each. No roasting action is permitted, as it is necessary to ship sulphide ore from Bisbee in order to obtain sufficient sulphur for matte formation. Oil



BEDDING BINS FOR FINE ORES AND CONCENTRATES

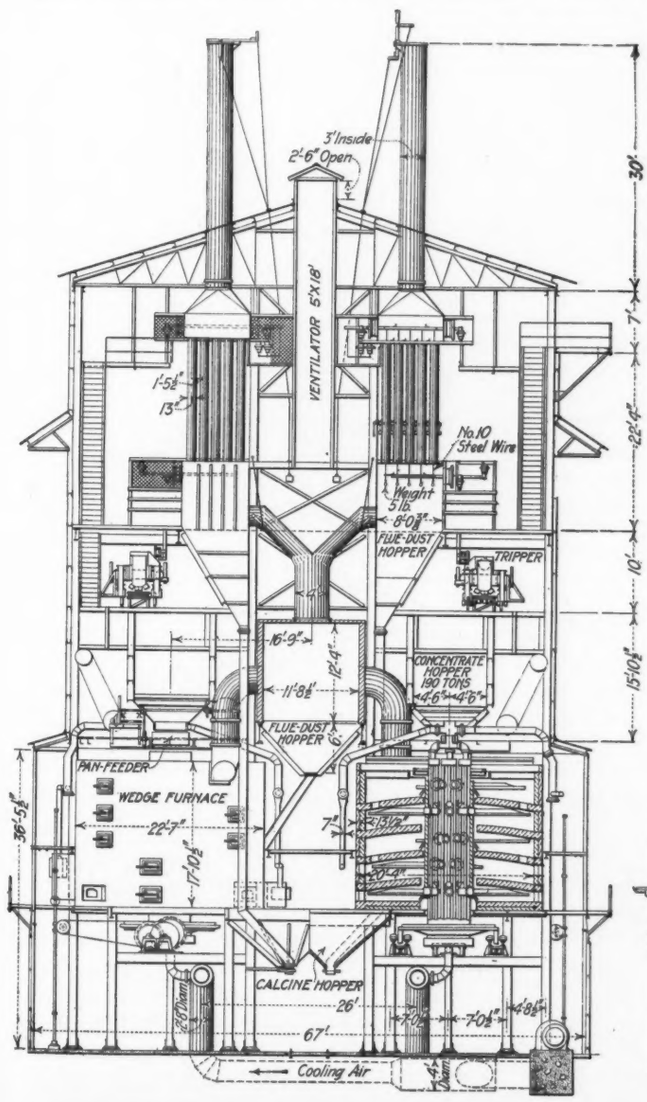
burners operating in combustion chambers supply the heat for drying. On account of the fineness of the concentrates, large quantities of dust are produced by the stirring of the rabbles, and provision for preventing the escape of this valuable material is made by the installation of the Cottrell system.

Cottrell Precipitators for Drier Plant

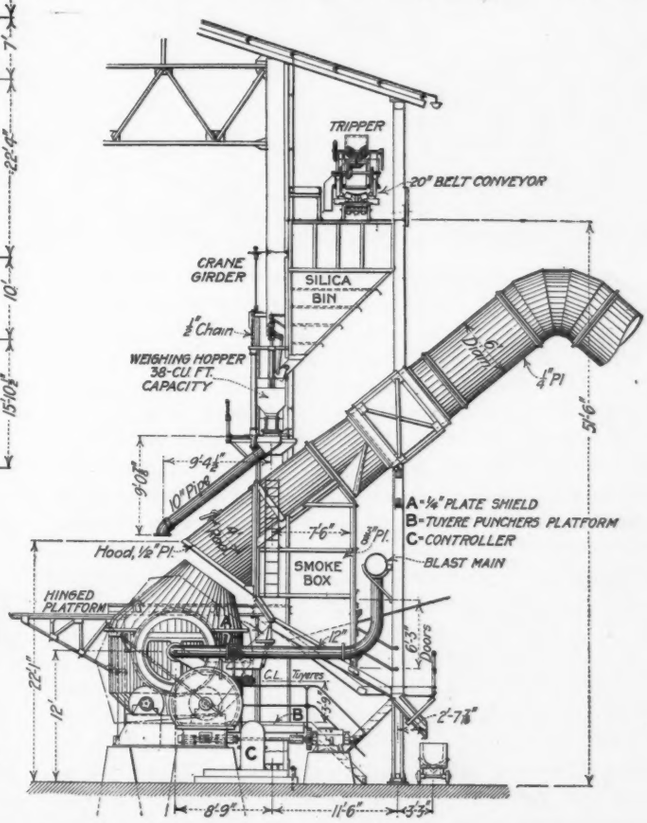
The Cottrell precipitation apparatus is mounted directly over the drying furnaces. The gases are drawn up through welded steel electrode tubes. These are 13 in. outside diameter, by 15 ft. long and 0.2 in. thick; they are belled outward and flanged at each end, where they are riveted to the header sheets. Twenty of these tubes comprise a unit, having a separate gas intake, chimney and electrical connection. The other electrode is a wire (ungrounded) running axially in the center of the pipe. A light steel frame, supported on insulators, enters the hood through circular openings in the glass windows. One such frame is used at the top to support the electrode wires, which are spaced at the bottom by a similar frame. A 5-lb. cast-iron weight at the bottom of each wire holds it taut. At intervals the gas is shut off the units, one at a time, by means of dampers, the voltage switched off and the tubes rapped, or vibrated, to shake off the dust adhering to the electrodes. The latter operation is performed by means of multiple-pendulum hammers, which are hand-operated. The blow is longitudinal and is received on the under side of a steel lug welded to the pipe.

The dried concentrates are taken to the reverberatory charge hoppers in 18-ton steel larry cars. In order to avoid the loss of the fine, rich material by being blown away, the car boxes are entirely inclosed and provided with four receiving chutes of special design. A cast-steel collar, 8 in. deep, with a hole 16 in. in diameter, forms the chute opening in the car top. Within this collar the steel chute works. When traveling, the chute is in the lowered position, but when the car is spotted under the dust hoppers, the chute is raised by a lever until it fits against the wide bottom flange of the hopper gate. These gates have the same spacing as the chutes carried by the car, so that all four gates may be operated at one time. Provision is made for allowing the air in the car to escape at the top, through a screened vent. When the car is spotted over the reverberatory feed hoppers, similar chutes are raised up against the gates of the car. While the car is emptying, the air is allowed to escape from the bin through pipes into the furnace.

Three reverberatory furnaces, having hearth areas of 21x120 ft., were installed. They are oil-fired and discharge their gases through Stirling boilers, according to the usual practice. Two tracks cross above the reverberatory furnaces near the firing end, for bringing the material to the feed hoppers. Four hoppers are provided near the center of the furnace for the main charge and four hoppers at the furnace sides for fettling material. The fet-



DRIER PLANT, CONSISTING OF WEDGE FURNACES AND COTTRELL PRECIPITATORS



GENERAL ARRANGEMENT OF CONVERTERS AT INTERNATIONAL SMELTERY, MIAMI, ARIZ.

tling is conveyed along each side of the furnace by a scraper conveyor. Flights carried on a link belt scrape the material along a lined trough. Connection is made through the arch by 6-in. cast-iron pipes, 2 ft. 6 in. apart.

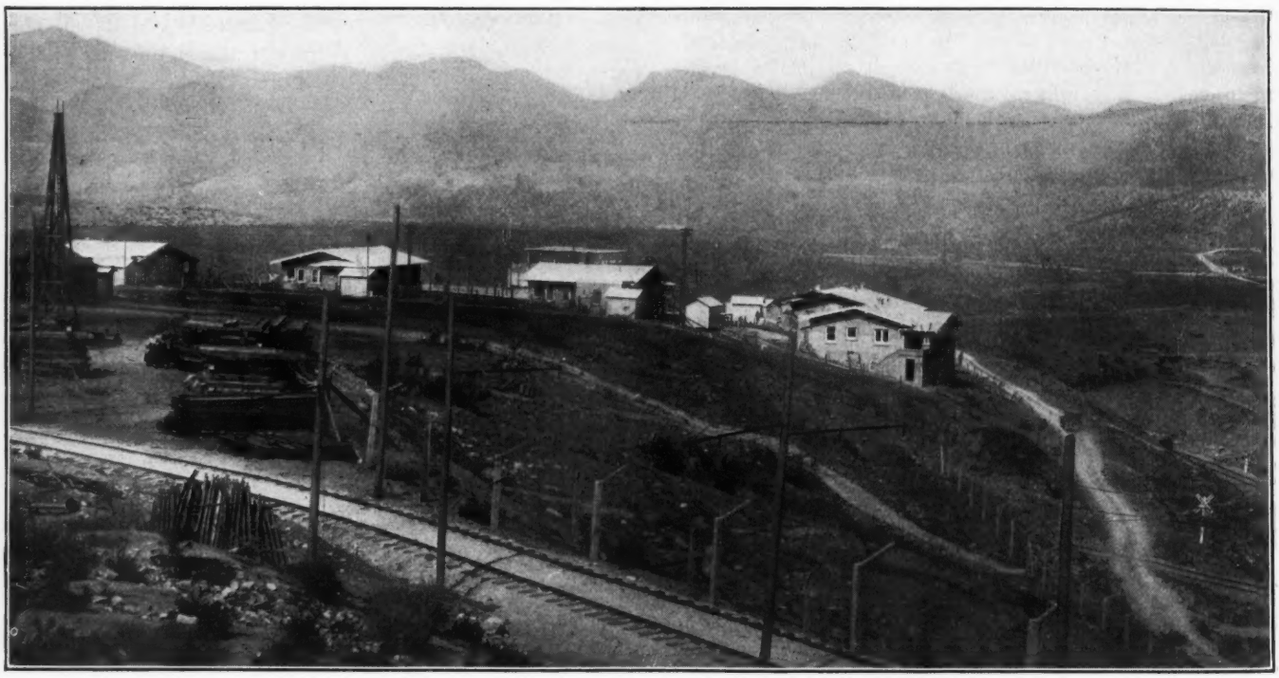
There are five converter stands for standard 12-ft. Great Falls type converters. The converters are tilted by means of 50-hp. alternating-current motors. Launders are provided for returning the converter slag to the reverberatories. Over the converters are placed silica bins, which are filled by belt conveyors. Weighing hoppers are provided below the silica bins for determining a definite amount of charge. This charge is delivered to the mouth of the converter by a pivoting spout. The spout is a 10-in. standard wrought pipe, projecting outward on a slope of 10 in 12. A hopper casting at its upper end receives the material and forms a pocket for the counterweight of scrap iron. The entire spout is suspended by a chain attached near the center of gravity, and its turning movement about a vertical axis takes place around a 4-in. pipe shaft, each end of which works in a bearing and through which the supporting chain passes. When not in use the spout is swung to one side by means of a light chain attached to the outer end.

The other auxiliary equipment of the converter plant comprises two 40-ton, 3-hoist electric cranes, with magnet-switch controllers, two casting machines, a McGregor skullbreaker and a Cottrell plant for treating the converter gases. The casting machines are of the straight-line type and each is served by a tilting furnace, 5 ft. 6 in. by 16 ft. 6 in. The latter provides storage for copper until it is desired to start the casting operation. Meanwhile the furnace is maintained at the desired temperature by an oil burner.

The McGregor patent skullbreaker at Miami, as well as the one at the United Verde works, has several improvements over the first skullbreaker installed under these patents. The machine is placed in the crane aisle, enabling the crane to deposit the skulls directly on the grating. The grating area is 12x24 ft., giving ample storage and avoiding the necessity of moving the skulls before crushing them. The whole structure is high enough to permit the spotting of an ore car directly beneath the grating to receive the crushed material.

The converter gases are conducted through goosenecks 6 ft. in diameter to a balloon-shaped header flue, which parallels the Cottrell electrostatic treaters. Short downtakes from this header flue connect the individual units, or treaters, and these in turn unite in a common header leading to the chimney. The details of electrodes, knockers, etc., are similar to those used in the drying-plant treaters.

The electrical apparatus required for the two Cottrell plants has been placed on the top floor of the drier building. Ten units are installed, each consisting of a 440-volt induction motor, a 15-kw. single-phase, 440-volt generator, a rotary switch, and a 440-100,000-volt transformer. The generator and rotary commutating switch are direct-connected to the motor, thus always being in synchronism. The current from the generator is raised by the transformer to 50,000 volts or more and then rectified by the switch for use in the treaters. Any voltage between 25,000 and 100,000 can be obtained. Two exciter sets and the switchboard are conveniently located in this room.



DWELLINGS AND STAFF BUILDINGS AT INTERNATIONAL SMELTING PLANT, MIAMI, ARIZ.
Note the roof garden on the building in center of the picture

A thoroughly modern power plant is owned and operated jointly by the Inspiration Consolidated Copper Co. and the International Smelting Co. The main units are three 6,000-kw. turbo-generators and three cross-compound 15,000-cu.ft. blowing engines. The steam required by the power plant is obtained from the waste-heat boilers at the reverberatory plant and from the oil-fired boilers adjacent to the power house. Modern auxiliary apparatus is provided for condensing, automatically measuring steam, feed water, temperatures, pressures, etc., and everything has been done to obtain the highest degree of efficiency.

Electrolytic Zinc*

By W. R. Ingalls

SYNOPSIS—General discussion of conditions governing production of electrolytic zinc. Description of Anaconda process. Commercial and technical limitations. Quality of electrolytic spelter.

Without any doubt, the most important thing in the metallurgy of zinc in 1915 was the inauguration of electrolytic zinc production direct from ore on a large experimental, even a commercial, scale at several places, the most important of these being at Anaconda, Mont., where the production of electrolytic spelter at the rate of about 5 tons per day was begun. The results are considered so favorable that the Anaconda company has commenced the erection at Great Falls, Mont., of a plant capable of producing 35,000 tons of electrolytic spelter per annum.

Chemistry of the Process

The chemistry of the process used at Anaconda is described in U. S. Pat. No. 1,167,700, granted to Frederick Laist and Frederick F. Frick, Jan. 11, 1916. According to this the proper performance of the cycle depends upon the presence of manganese. Its function is to serve as a carrier of oxygen for the oxidation of ferrous to ferric iron, thus rendering possible a complete separation of iron and affording a purified solution from which zinc may be recovered by electrolysis. In the course of this electrolysis the manganese is restored to a state of oxidation higher than the manganous state, and thereby becomes available for re-use in the process.

The calcined ore is treated at a temperature of 50 to 65° C. with sufficient dilute sulphuric acid so that there is 5 to 10% excess acid over that required to complete the reactions, by which the metals in the calcined ore are dissolved. A portion of the iron enters into solution as a ferrous salt, in which state it is not completely removed by the usual basic precipitants (lime, zinc oxide, etc.) It is necessary, therefore, to oxidize this ferrous iron, and in the cyclic operation of the process this is accomplished through the agency of the manganese, which enters the cycle at this point in one of its higher states of oxidation—as for instance, in the form of manganese dioxide. The oxidation of the ferrous sulphate takes place according to the equation,

$$2\ FeSO_4 + MnO_2 + 2\ H_2SO_4 = Fe_2(SO_4)_3 + MnSO_4 + 2\ H_2O$$

Having accomplished the leaching and having a slight excess of acid solution, sufficient milk of lime or zinc oxide is added to render the solution neutral or slightly basic. The iron and most of the other impurities except copper are precipitated, and the precipitated impurities are so coagulated that filtration is very rapid.

The solution, purified from elements harmful to electrolysis, is subjected to electrolysis using insoluble anodes—as lead, for example—and suitable deposition blanks or zinc starting sheets for cathodes. The electrolytic reactions are:

$$ZnSO_4 + \text{current} = Zn + SO_4$$
$$SO_4 = SO_3 + O$$
$$SO_3 + H_2O = H_2SO_4$$

The oxygen liberated from the SO_4 at the anode effects the oxidation of the manganese; thus,

$$2\ MnSO_4 + 2O + 6\ H_2O = 2\ HMnO_4 + 2\ H_2SO_4$$
$$2\ HMnO_4 + 3\ MnSO_4 + 2\ H_2O = 5\ MnO_2 + 3\ H_2SO_4$$

It is apparent from the foregoing that a regenerated sulphuric-acid solution containing manganese in higher stages of oxidation than the manganous state results and is directly available for leaching additional portions of roasted ore, where the higher oxides of manganese are available for oxidation of ferrous iron and are themselves reduced to manganous sulphate, thus making a cyclic process in which the desirable manganese may be used over and over again and in which the original supply or any deficiency may be supplied to the raw zinc ore or concentrates in the form of carbonate or sulphide ores of manganese.

Details of the Process

In the performance of the process the ore is roasted in Wedge furnaces at a temperature of 900° C., which, with a fuel consumption of 5 to 6%, delivers a product containing only about 0.3% S as sulphide. The roasted ore is leached in a Pachuca tank with air agitation, the lixiviant being spent solution from the electrolytic cells. The percentage of zinc dissolved is from 85 to 95. After addition of limestone to neutralize free acid, the pulp is run to a battery of Minerals Separation flotation agitators, where it is agitated and aërated to precipitate ferric hydrate. The charge thence passes to a Dorr thickener, which delivers clear overflow to solution storage tank and mud to Oliver filter. The latter gives cakes of gangue containing iron, lead, silver, etc., which go to blast furnaces, and solution which is united with that overflowing from the Dorr thickener.

From the solution tank the liquor is drawn into a tube mill filled with zinc balls, which precipitate copper and cadmium, flowing thence to a circular filtering tank having a quartz bottom, and finally to a Shriver plate and frame filter press, which completes the clarification. The purified solution goes to a cascade of 21 electrolytic cells, whereof there are two series, and upon entering, is mixed with one-half of the spent electrolyte from the tail cells, which brings the cell feed up to 2½% free H_2SO_4 and 5% Zn.

In flowing through the cells the temperature of the electrolyte is kept below 70° C. by means of lead coils conducting cooling water, which is done in small boxes interposed between the cells. The anodes are of pure lead, the cathodes of aluminum. Solution is electrolyzed at a current density of 23 amp. per sq.ft., the voltage drop being 3.8 to 3.4 volts per cell, decreasing as the acid increases. Current efficiency is 93 to 94%. The cathode is finished within 48 hr., by which time it has attained a weight of 50 lb. and is then peeled from the aluminum sheet.

*A paper presented at a joint meeting of the New York Sections of the American Electrochemical Society, the American Chemical Society and the Society of Chemical Industry, on Feb. 11, 1916, but somewhat further elaborated for this publication.

Apart from the Anaconda work the most ambitious plans carried on in 1915 were those of the Consolidated Mining and Smelting Co. of Canada, which continued the experimental work begun several years ago. In the last official report of this company it is stated that spelter of good grade has been produced at the rate of 1,000 lb. per day from ore from the Sullivan mine, and that the results were sufficiently promising to warrant the building of a plant capable of producing 25 to 35 tons of spelter daily. Construction of this plant is well advanced, and it is expected to be in operation early in 1916.

Electrolytic zinc was also produced in 1915 on an experimental scale by the Electro Zinc Co. at Welland, Ont., while some work in this line was done at Keokuk, Iowa, and at Bully Hill, Calif., and there were one or two other operations (one of these employing the Isherwood process) that may not yet be mentioned publicly. The work at Welland is unique in that the dissolving of the zinc and the electrolysis of the solution are performed in the same vat, the cathodes being inclosed in canvas bags. All of the other work, so far as I know, is being done on lines similar to those at Anaconda.

Before going any further, let it be well fixed in the mind that the conditions that have existed in the zinc industry during the last year are not only unprecedented, but also it is certain that they cannot be otherwise than ephemeral. They have been due to a shortage of metallurgical capacity, not of ore in the least degree, and that shortage is being reduced with extraordinary rapidity. In the meanwhile, however, there has naturally been a huge metallurgical margin—even $60 per ton of ore against a normal of about $15—in the manufacture of common spelter, and with such a margin it has been good sense not only to commit metallurgical crimes, but also to institute new processes that would not ordinarily be profitable. In the manufacture of high-grade spelter the margin has been much higher, so much so that the possibility of it would two years ago have been considered nothing less than preposterous.

Now, the electrometallurgy of zinc is no new thing. The electrolytic refining of impure spelter was tried on a large scale by Nahnsen in Upper Silesia in the '90s, the hydrometallurgical-electrometallurgical treatment of zinc ore was essayed disastrously by Ashcroft at Cockle Creek, N. S. W., in a works costing about one million dollars. Doctor Hoepfner developed a process that was put into use at Führfort on the Rhine and at the works of Brunner, Mond & Co., at Winnington, in England. At the former it was abandoned after a short time; at the latter it has been continued through a long series of years, making a few hundred tons of spelter annually, and is in use at the present time. The electrometallurgy of zinc has therefore a commercial history of respectable antiquity.

Difficulties in the Art

In the early days of the art, both commercial and experimental, difficulty was experienced in obtaining dense deposits on the cathodes, spongy zinc being a stumbling block, but while this matter required some study for its mastery, it was manifest that the real difficulties of this process were the getting of zinc into solution rather than out of it and the large amount of power required for zinc precipitation.

With regard to the former point, I refer to the formation of insoluble ferrite of zinc in roasting, with the consequence of relatively low extraction of zinc. That is experienced in the case of many, perhaps most, ores that it is desired to treat. To illustrate, roasted Joplin blende may be leached with sulphuric acid so as to cause it to give up 97 or 98% of its zinc, the residue being a white silica sand, but nobody wants to treat Joplin ore by a hydrometallurgical process, for the reason that it would be less economical than ordinary smelting. On the other hand, certain mixed ores high in iron, like those of Leadville, Colo., may give up only about 65% of their zinc. So low an extraction would in itself be prohibitive in most circumstances in ordinary times. It is possible that the roasting might be conducted in such a way as to steer clear between the Scylla of zinc ferrite on the one hand and the Charybdis of undecomposed zinc sulphide on the other hand, but that question has not been investigated with definite results, so far as I know. With regard to the high power required for the electrolysis of zinc solutions with insoluble anodes, the expense of it, when imposed upon the cost of roasting, leaching, remelting cathodes, reworking between-products, etc., is likely to make the cost of hydrometallurgical-electrometallurgical zinc extraction too high to be ordinarily considered.

I have therefore repeatedly expressed the opinion that metallurgical processes of this sort were unlikely to be successful commercially, unless: (1) Exceptionally cheap hydro-electric power, such as the $6 or $7 per annual horsepower of Norway and Sweden, were available; or (2) unless use could be made of the anode reaction, such as the liberation of chlorine by the electrolysis of a chloride solution and the employment of it for some chemical manufacture, as at Winnington, England; or (3) unless certain especially favorable conditions otherwise existed. By the last I mean such things as high grade of the run-of-mine ore, a kind of ore that will give up a high percentage of zinc by lixiviation with sulphuric acid, an ore high in silver and possibly lead. These points are almost determinative. In the pyrometallurgy of zinc the extraction of silver is, perhaps, about 65%. In the hydrometallurgy of zinc it ought to be upward of 90%, perhaps as high as 95%. The situation with respect to lead is somewhat similar. It is needless to dwell upon the importance of this in the cases of ore exceptionally high in silver.

Favorable Conditions at Butte

Now, in the treatment of the Butte ore at Anaconda about all of the favorable conditions that I have enumerated under the third head exist. The ore raised from the mine is of rather high grade, it is of a character that enables 90% of the zinc, or more, to be extracted by sulphuric-acid lixiviation, and as zinc ores go, it is exceptionally high in silver (the concentrated ore going 20 oz. silver per ton or thereabouts). Moreover, the Anaconda company is introducing zinc extraction in connection with its other great metallurgical work, thus dividing general and administrative expenses, etc. It is able to obtain moderately cheap power at Great Falls, and finally, what is not least in importance, it possesses about the best metallurgical organization of any concern in the United States and is instituting this new process at a time when there ought to be commercial profit in spite of any imaginable infantile disorders. I am not free to communicate such figures respecting the Anaconda

results as I know, but I may say that the Anaconda management is thoroughly aware of the exceptional conditions existing in the zinc industry at present, and is nevertheless of the opinion that with its peculiarly favorable circumstances it can continue the production of electrolytic zinc in competition with everybody else in normal times, or even in the hard times that may be experienced after the termination of the war. The promise of the development of the hydrometallurgy-electrometallurgy of zinc as a commercial art on a large scale has therefore already become a prospect. There is to be such an art. The magnitude that it will attain and its effect upon the zinc industry of the world remain for the future to tell, but that it is going to have an early and important influence is not to be doubted.

Turning attention to some of the technical features of electrolytic zinc production, the conditions governing the electrolysis of zinc solutions were exhaustively treated by Dr. Victor Engelhardt in a paper read at the first general meeting of the Gesellschaft Deutscher Metalhütten- und Bergleute and published in *Metallurgie* a few years ago. A summary of Doctor Engelhardt's conclusions, together with some additional notes, was published by Prof. J. W. Richards in "Transactions of the American Electrochemical Society," XXV, pp. 281-90. The ideas of Doctor Engelhardt, who is the chief engineer of the electrochemical division of the Siemens & Halske company, of Berlin, are exemplified in what are called the Siemens & Halske and Isherwood processes. However, in the late development of zinc electrolysis, "processes" and patents have played but slight part. With recent experimenters the matter of spongy-zinc deposits appears to have been among the least of the difficulties. Mr. Keating succeeded several years ago in depositing smooth, solid zinc on his cathodes at Bully Hill, Calif., while as for Mr. Laist, he accomplished this part of the process as a matter of course, just as simply as if he were depositing copper, the necessary precautions as to purity of solution, etc., being naturally taken.

Grade of Electrolytic Zinc

With regard to the grade of electrolytic zinc, high purity is easily obtained. This is something that is far more under control than in refining by fractional distillation. Lead ought not to go appreciably into solution at all, while iron, copper and cadmium—the other common impurities of spelter—are readily precipitated from the solution. The spelter first made at Anaconda was higher in cadmium than is permitted by the standard specifications for "high-grade." At that time zinc dust, more or less impure, was being used as the precipitant for cadmium. Running the clarified solution through a tube-mill filled with zinc balls corrected this, and the grade of the spelter was then raised to upward of 99.9%. Brunner, Mond & Co. have been for many years guaranteeing their electrolytic spelter at 99.95% Zn, and there is no reason why the Anaconda spelter should not be made as good as that.

Is electrolytic zinc extraction going to revolutionize the metallurgy of zinc? Unqualifiedly, no. When the zinc industry returns to its normal status, conditions will be in the main as they were before the war and the principles that I have previously stated will continue to obtain, with the difference that some people will have learned the details of the art, will have gone through the period of infantile mistakes in a time when almost any mistake was of no great consequence. By that time some of the concerns possessing exceptionally favorable conditions—Anaconda, if anybody—may be able to continue. Others will not.

However, there are certain new industrial features that cannot yet be clearly estimated and may have a modifying effect upon this forecast. One of these relates to the matter of high-grade zinc. Previous to the war that class of spelter was produced in limited quantity and sold at a premium over common spelter of about 2½c. per lb. Inventors, promoters and others who talked about making such zinc were discouraged from reckoning upon the premium by the dictum that the market would not take any more than the then supply, which was indeed artificially limited, and that it was unsafe to count on anything but the price for common spelter. During the war high-grade spelter has fetched 40c. per lb., and at times the demand for it has been insatiable. This demand has been especially in connection with the manufacture of ammunition and may be expected to cease with the war, but will the advertising that high-grade spelter has had and the wider knowledge of its peculiar properties that has been acquired give it a more extensive use in the peaceful arts and a maintenance of the premium for it, that will be to the advantage of the electrolytic producer? Or will it become a drug in the market, with entire disappearance of price differential? These are questions that nobody yet knows enough to answer reasonably.

The Bearing of Flotation on the Metallurgy of Zinc

Another new and uncertain factor is the bearing of the flotation process of ore concentration upon the metallurgy of zinc. I think that this had a good deal to do with the institution of the Anaconda work. About all metallurgical work is a sequence of steps of concentration and refining, treating the bulk of the ore by a cheap but wasteful process and delivering a concentrated product to a more costly but less wasteful process. Now, most experimenters in the hydrometallurgy and electrometallurgy of zinc heretofore have contemplated the application of a costly process to the run-of-mine ore. The flotation process has enabled ore to be concentrated at relatively small cost with but slight loss. Let it be observed, therefore, that Mr. Laist is applying his costly process not to run-of-mine ore, but to a flotation concentrate in which about 90% of the zinc is concentrated in about one-fourth of the original weight. This is the new and important feature of recent zinc electrolytic work.

We must let our thoughts run a little farther ahead. The treatment of flotation concentrate is one of the present troubles of the zinc smelter, owing to its excessive fineness, which produces difficulties that it would take me too long to describe. Yet the proportion of this class of ore that the zinc smelter is getting is still relatively small. The supply of it is, however, bound to increase, and when it becomes large, the troubles of the zinc smelter will really begin. Now the hydrometallurgist will have the same troubles up to and through the roasting of the ore, but he will be free from those that arise in the distillery. In so far he will have an advantage over his brother pyrometallurgist, but whether it will be a weighty advantage I do not venture to offer an opinion.

Another thing that may help the hydrometallurgist is improvement in the method of roasting. Twenty-five years ago he used to talk about sulphate roasting. He did not in practice find that idea to work out as well as he expected. While he might be able to render 40 or 50% of the zinc soluble in water, he found there was too much undecomposed sulphide left behind after leaching with sulphuric acid. So then he said he would roast the ore completely, leach all the zinc with sulphuric acid and be done with it. To his surprise he found that much of the zinc had been rendered insoluble by the formation of zinc ferrite if iron were present in the ore, as was almost always the case. The roasting of ferruginous blende in such a way as to convert all of the zinc into sulphate and oxide, avoiding both sulphide and ferrite, which may perhaps be done by correct control of temperature, perhaps by some other control, is an interesting subject for investigation. Mr. Laist has given some attention to this by carefully limiting the temperature of his roasting furnace. However, I think that perhaps the danger of ferrite formation is not very great in the case of his ore. Anyway, I know that it is not in roasting some similar ore of Butte without much regard to the matter of temperature.

New Honduran Mining Laws

While several of the Latin-American countries are passing or proposing to pass laws putting a tax on the activity of mining companies, Honduras has under consideration a bill to tax inactivity. A bill submitted requires working of mining claims instead of payment of annual rental fee and is expected to release extensive areas that have been tied up for years by the payment of a small annual rental.

A correspondent of the *Evening Post* sends the following translation of part of the address of Señor Lopez, Minister of Public Works, who transmitted a draft of the proposed law to the national Congress, now in session at Tegucigalpa:

From colonial times until the end of the past century the mines of Honduras were given on condition that the grantees would work them continuously. The course taken by the enterprise at San Juancito (New York & Honduras Rosario Mining Co.) and the example of Mexico obliged us to enlarge our mining claims and to create zones. But we continued with our old system to help those mines and zones. The old system filled the coffers of the Spanish treasury with gold and silver, and later gave enough for coining into national money and to sustain our commerce; for we paid with ingots of gold and silver for the merchandise we imported from Europe and the United States.

The changes that, with the best intention, were made in our mining laws in 1899, substituting an annual rental for the working of mining claims, ended the production by miners and left us with idle zones alone. It may be figured that grantees hold unproductive 68,000 hectares (about 170,000 acres), by payment of a small amount to the Treasury Department. They hold these zones, not to work them, but with a hope that foreigners will come to do this and buy the zones at a good price. These properties that are in a way withdrawn from use include the famous mines of Santa Lucia and of Yuscarán, of San Antonio and of Valle de Angeles and others. The inhabitants of these places, who before the change mentioned gained their living near their homes, today have abandoned these and scattered in search of work. Such a condition cannot continue, because it halts the progress of one of the first industries of the country.

Based on these reasons is a bill that is submitted for consideration by Congress. In it is scarcely a clause that is not taken from the old laws. It does not propose to take any mining zone from anyone, but does require that they shall be worked. Countries richer than Honduras have adopted measures more radical than those now proposed, to save the mining industry.

Report of Utah Copper Co.

The report of the Utah Copper Co. for the final quarter of 1915 shows a production of 44,224,715 lb. of copper—16,004,607 lb. in October, 13,722,723 lb. in November and 14,497,385 lb. in December. Average monthly production for the quarter was 14,741,572 lb., and for the year, 13,017,281 lb. The gross production for the year was 156,207,376 lb.

The ore milled during the quarter was 2,384,400 tons, a daily average of 25,917 tons having an average assay of 1.4694% copper. The average extraction was 63.11%. Average cost of net copper produced was 6.10c. per lb. after making allowance for smelter deductions and crediting miscellaneous income, including earnings of the Bingham & Garfield Ry.

Total net profit for the quarter was $6,919,203; dividends paid, $2,436,735, leaving net surplus of $4,482,468. Earnings are computed on a basis of 21.408c. per lb. for copper; all unsold stocks and copper in transit is carried at 13.5c. per lb. Dividend paid Dec. 31 was at rate of $6 yearly, 50c. per share more than for the previous quarter.

California Oil in January

The average daily production of 223,364 bbl. of crude petroleum in California in January was a reduction of 13,229 bbl. from the December daily production. The loss was due to the effect of the storms of Jan. 17 to 27, which destroyed 1,870 derricks in the San Joaquin Valley fields. January shipments were below normal, totaling 7,035,436 bbl. The loss in shipments was due chiefly to the interruption of railroad services caused by the rain. During the month 35 wells were completed, showing total initial production of 4,395 bbl. daily. Shut-in production remains constant at 12,000 bbl. daily. Total crude-oil stock at Jan. 31 was 57,035,887 bbl.

Standard Oil Co. of California advanced price of fuel oil 5c. per bbl. of 42 gal. at all Pacific Coast points on Feb. 16. This makes the price at San Francisco Bay 90c. per bbl. Prices for crude oil at the wells in the San Joaquin Valley and the Whittier-Fullerton fields advanced 5c. per bbl.; no change in Ventura fields. Standard Oil Co. has advanced price of gasoline from 17c. to 18c. per gal. This is the second advance in February and makes a total of 6c. The reason alleged to have been given is that the storms curtailed the production of crude oil in the last half of January and that the price of crude at the well has been advanced.

Phosphate in Wyoming

The results of a geological reconnaisance for phosphate in the Salt River Range of Wyoming, by G. R. Mansfield, of the United States Geological Survey, are given in a brief report showing the situation and character of beds of rock phosphate of medium grade on the west flank of that range.

This investigation is part of the exploratory work and mapping which the Geological Survey is doing in the Western phosphate field. The work has already resulted in the discovery of beds of phosphate, some of it of high grade, aggregating many million tons. The present report is designated Bulletin 620-0 and may be had on application to the Survey.

Sedimentation and Flocculation*

By E. E. Free†

SYNOPSIS—The properties of colloidal slimes are due solely to the normal behavior of suspensions of fine mineral particles, without reference to hypothetical gelatinous substances. Flocculation and substances promoting or interfering with that condition are considered.

As pointed out in the preceding paper of this series, one of the two difficulties encountered in handling the so-called colloidal slimes is the extraordinary slowness with which they settle. It is not unusual to encounter slimes a fraction of which do not settle at all, remaining permanently as a greater or lesser turbidity in the overlying solution. Less striking, but of vastly greater practical importance, is the long time required for the subsidence of the portion that does settle, there resulting serious delays in thickening or a necessity for discharging incompletely thickened slimes. This matter of the relation between colloidal character and the phenomena of settling is the subject of the present article, but as a preliminary we must recall the essentials of the particulate theory of colloids as developed in the previous article, especially the conception of colloids as consisting of extremely fine particles distributed through a dissimilar medium and of colloidal slimes as no more than slimes the particles (or some of the particles) of which are extraordinarily fine. From this standpoint it was concluded that the degree of colloid difficulty with a slime—what we may call its colloidality—will increase or decrease as its particles become finer or coarser. The admitted discrepancies between this statement and the results of screen tests were stated as due in part to the fact that the particles of the troublesome fraction of the slime are smaller than the sizes distinguished by usual screen analyses and in part to the phenomena of flocculation, which phenomena we are now preparing to discuss. Of the conclusions of the previous article it may be recalled, also, that the current hypotheses of specific, gelatinous colloidal substances present in ores and slimes was rejected and that we are attempting to explain the properties of colloidal slimes as due solely to the normal behavior of fine mineral particles suspended in an aqueous medium.

Formulas for Slime Settling

When a single mineral particle falls freely through water it soon attains (if it is not larger than coarse sand or gravel) a constant velocity which is maintained thereafter regardless of the distance it falls. For the mathematical expression of this constant velocity in the case of the free fall of a spherical particle two formulas are in general use. Among metallurgists it is customary to employ the formula of Rittinger,[1]

$$V = K\sqrt{D\,(\delta - 1)}$$

in which V is the velocity, D is the diameter of the particle, δ is its specific gravity, and K is a constant, the numerical value of which depends upon the shape and surface character of the particle. Among physicists preference is given to the more general formula of Stokes,[2]

$$v = \frac{2}{9k} r^2\,(d - d')\,g$$

in which v is the velocity, r is the radius of the particle, d and d^1 are the densities of the particle and medium respectively, g is the acceleration of gravity and k is a constant depending upon the viscosity of the solution. It is manifest that the two formulas are widely variant, especially in the power of the radius to which the velocity is related. It is impossible here to enter into detailed discussion of this difference[3]. It must suffice to say that for the smaller particles the Stokes formula not only has a sounder derivation, but is in better accord with what experimental data are available[4]. The following discussion is based upon the Stokes formula.

Considering this formula and ignoring the self-evident effects of gravity and of the difference in densities, it is apparent that the velocity of fall of a particle will vary directly with the square of its radius and inversely with the viscosity of the medium through which it falls. The chief departures from this formula that are encountered in experiment occur with the smaller particles, these falling more slowly than is required by the theory. It is probable that these deviations are due to several forces, active only in the case of the finer particles and not taken into account in the formula, of which forces the chief appear to be molecular bombardment and electric charges on the particles. The possible efficacy of repulsive electric charges in modifying the rate of fall is obvious. Knowledge of the importance of molecular bombardment results from recent studies of the rapid vibratory movement always exhibited by fine suspended particles and known as the Brownian movement, after the celebrated botanist, Robert Brown, who discovered it in 1828.[5] During the past decade the mathematical studies of Einstein and von Smoluchowski and the experimental investigations of Perrin, Svedberg and others have resulted in a convincing demonstration that the Brownian movement is due to bombardment of the particle by the rapidly moving single molecules of the medium, this being the first direct demonstration of the kinetic conception of matter.[6] From this it follows that fine suspended particles have in some degree a tendency to become distributed throughout the

*This is the second of a series of articles on Colloids in Ore Dressing. The first appeared in the "Journal" of Feb. 5, 1916. The third, a continuation of the present article, will appear in an early issue.

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[1]"Aufbereitungskunde," pp. 165, 195, 270 (1867).

[2]"Trans. Camb. Phil. Soc.," Vol. IX, Part II, pp. 51-2 (1850). For more recent treatments see Cunningham, "Proc. Roy. Soc." (London), Ser. A, Vol. LXXXIII, pp. 357-65 (1910) and Lamb, "Phil. Mag.," Ser. 6, Vol. XXI, pp. 112-21 (1911).

[3]It appears to be a matter of velocity of fall, the Rittinger formula holding above a certain critical velocity, the Stokes formula below it. See Carrick, "Proc. Chem. Met. Soc. S. A.," Vol. II, pp. 797-8 (1898); Richards, "Trans. A. I. M. E.," Vol. XXXVIII, pp. 234-5 (1908); Stadler, "Trans. I. M. M.," Vol. XXII, pp. 686-701 (1913).

[4]For the most important of these data see Rittinger, "Aufbereitungskunde," p. 195 (1867); Thoulet, "Ann. de Mines," Mem. Ser. 8, Vol. V, pp. 507-30 (1884); Munroe, "Trans. A. I. M. E.," Vol. XVII, pp. 637-59 (1889); Richards, ib., Vol. XXIV, pp. 410-26 (1894), and Vol. XXXVIII, pp. 210-35 (1908); Jarvis, ib., Vol. XXXIX, pp. 451-521 (1908).

[5]"Edinb. Phil. Journ.," (n. s.) Vol. V, pp. 358-71 (1828); "Edinb. Journ. Sci.," (n. s.) Vol. I, pp. 314-20 (1829).

[6]For a review of this subject, with citations of literature, see Wo. Ostwald, "Grundriss der Kolloidchemie," 2nd ed., pp. 231-61 (1911).

medium, a tendency similar in kind to the diffusion tendency of a gas or of a dissolved substance, but much less intense. The possibility of resulting modification of the Stokes formula is obvious.

Causes of Permanent Suspension

Furthermore, it must not be forgotten that in actual experiment we seldom deal with a medium entirely free from convection currents and even less often with particles that are perfect spheres. Any such disturbances in the medium or irregularities in shape of the particle will operate to retard settling, and it is obvious that the rates of fall actually found may be importantly below those expected on the basis of the formula. With the exception of molecular bombardment none of these disturbing factors has been reduced to precise formulation, and even in this one case the mathematical treatment requires assumptions of such rigor as to be nearly, if not quite, unattainable in practice. However, all of these disturbing factors lead to decreases rather than increases in the rate of settling called for by the formula, and it is possible to regard the formula as an expression of the limiting maximum velocity that a given particle can attain in a given medium. The actual velocity will be always smaller than the theoretical. This is confirmed by the results of experiments with suspensions. From the presence in the formula of the square of the radius of the particle it follows that the velocity of fall decreases rapidly with decrease in particle size. In this and in the fact that all deviations are toward lesser rather than greater rates lies the cause of the extremely slow rates of subsidence exhibited by fine clays, slimes and the like. Indeed, when we deal with ordinary mineral particles in an aqueous medium and under the usual conditions of experiment or of metallurgical practice, single particles entirely cease to subside, although large enough to be microscopically visible and considerably larger than the diameter established by the Zsigmondy table as the upper size limit of truly colloidal particles.[7] This means that suspensions that are not fine-grained enough to be colloids at all, in the strict technical sense of the word, are capable of permanent suspension and that much of the material of many slimes would not settle at all were it controlled only by the factors mentioned. A large fraction of the slime material treated in the United States comes under this category, and on the basis of the Stokes formula and the described deviations it would be expected never to settle at all. The fact that slimes do settle and that the situation is not so bad as would be inferred from the theory outlined brings us to the matter of flocculation.

Flocculation and Deflocculation

Flocculation is the technical term for the gathering of suspended particles into aggregates. Its nature is illustrated by Fig. 1—a suspension of lampblack before and after flocculation by the addition of sulphuric acid. In the flocculated suspension the fine particles of lampblack have gathered into great flocks easily visible to the eye (the figure is natural size). Passing over for the present the ways in which this flocculation can be produced or destroyed, let us examine the effect it will have on the rate of settling. It is apparent that an aggregate of many particles will behave to some degree like a single larger particle, although one of very irregular surface. It follows that flocculation changes the suspension from one of a multitude of tiny particles to one that behaves as though it were composed of a relatively small number of larger particles. The average effective radius of particle is increased, and the Stokes formula indicates the increase that may be expected in the rate of settling, it being remembered that this increase will correspond to the squares of the respective radii. Experiment is fully confirmatory. The flocculated suspension of Fig. 1 had entirely subsided in two minutes, whereas the unflocculated suspension was permanent and did not subside at all. It is useless to multiply examples of this fact.

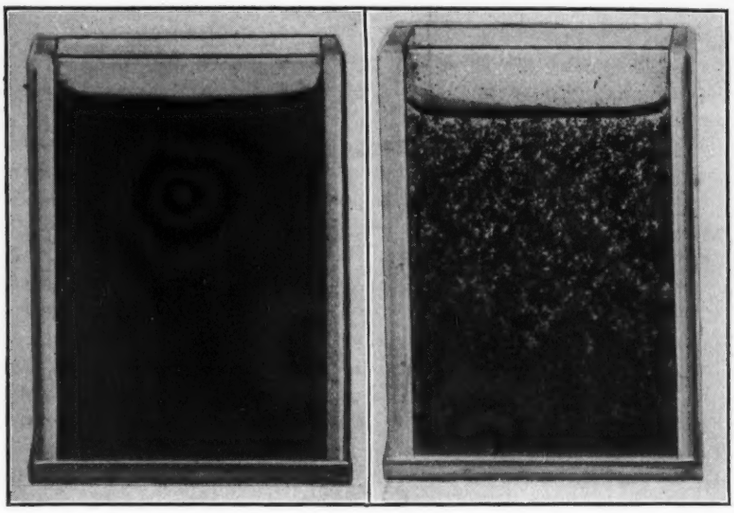

FIG. 1. SUSPENSION OF LAMPBLACK BEFORE AND AFTER FLOCCULATION

Practice confirms theory in the conclusion that the rate of settling may be largely increased, even multiplied by hundreds or thousands, by the flocculation of the suspended particles. Herein lies the explanation of much of the anomalous behavior of colloidal slimes. Slimes settle faster or more slowly not only in response to the actual size of the ultimate mineral particles, but also in response to the more or less complete flocculation of these ultimate particles into larger or smaller aggregates. These floccules are not permanent enough to persist through screen testing even if it could be carried to their dimensions, and the reason for the failure of such tests to agree with the degree of colloidality encountered in practice is clear.

It should be noted that flocculation and its opposite, deflocculation, are purely relative terms like, for instance, "high" and "low" or "smoothness" and "roughness." A suspension is more or less flocculated merely with reference to some other suspension. For this reason it is preferable to use the concept of "degree of flocculation" rather than to refer to suspensions as "flocculated" or "deflocculated." Precision in the determination of this degree of flocculation is not yet possible. There is no known method for the accurate measurement of floccules or the counting of their constituent particles, and even

[7] One-tenth micron. See the preceding article, "Eng. and Min. Journ.," Feb. 5, 1916.

if there were, it is probable that the individual floccules of a single suspension would vary widely and irregularly among themselves. For the present the whole matter must remain purely relative and the only measures of the degree of flocculation must be comparative and indirect.

Usually one thinks of flocculation as an active process, as something done to the suspension, and it is natural to conceive the normal condition as a condition of no flocculation at all. Thus, knowing that clay suspensions are flocculated by dissolved sodium chloride, one thinks of a clay suspended in pure water as possessing a zero degree of flocculation and existing as single particles with no aggregation whatever. This does not appear to be the case. Dr. F. K. Cameron and the writer, working with kaolin suspensions, found that there is a considerable degree of flocculation even in suspensions in the purest obtainable water and that by adding various substances (the so-called "deflocculators") it is possible to prepare suspensions having lower degrees of flocculation. It is not entirely certain that this residual flocculation is really characteristic of absolutely pure kaolin in absolutely pure water. Flocculation reactions are extremely sensitive, and the difficulty of obtaining perfect purity of materials is very great. It is possible that the flocculation observed with supposedly pure materials was really due to undetected traces of flocculating impurities. However, this theoretical possibility has little practical importance. Normal mineral powders, including all ordinary slimes, display a considerable degree of flocculation when suspended in pure water. This is why normal slimes are always more or less flocculated even when no flocculating agent has been added or is known to be present. Indeed, it is probable that much of the trouble with colloidal slimes is due to the accidental presence of substances acting as deflocculators and which tend to destroy the flocculation that would normally occur.

Changes of Flocculation

The degree of flocculation is extremely sensitive to surrounding conditions; so sensitive, indeed, that changes of flocculation in the true colloidal solutions are among the most delicate of analytical reactions. These changes and similar ones in the coarser suspensions may be caused by many kinds of influences. Temperature, light, the radiations from radium, electrostatic charges and many other variations in energy relations all appear to have perceptible effects. However, these effects of direct energy changes are far less important practically than the effects of added substances, and it is these latter alone that require consideration here. A large amount of observation and incidental experiment going back for many centuries has sufficed to establish three general classes of substances which effect the degree of flocculation or, as it is generally conceived, the rate of settling of suspensions. First are the neutral inorganic salts and the inorganic acids, all of which increase the degree of flocculation and promote settling. Second are the alkalis which (in certain concentration) have the reverse effect, decrease the degree of flocculation, hinder settling and are known as "deflocculators." Third are the organic colloids of the liquid-particle type (emulsoids) such as gelatin, albumin and the like. The effect of these is somewhat complex, but in general they also decrease the degree of flocculation, or at least prevent its increase. Passing over for the moment any discussion of the causes of these effects, let us examine briefly the details of the phenomena.

This can be done most easily by the consideration of actual cases. First is a series of measurements of the flocculating effect of sodium chloride upon kaolin suspensions recently made by Herbert F. McCall under my direction.[8] The data are shown graphically in Fig. 2, the degree of flocculation being expressed upon the vertical axis, the concentration of sodium chloride upon the horizontal. For convenience the scale of the horizontal axis is cubed. Of course the degree of flocculation cannot be set down in any absolute or standard units. The curve expresses no more than the relative degree of flocculation of suspensions in solutions of different concentration and has, so far as its vertical dimension is concerned, only a roughly quantitative value. From this curve it is apparent that in extremely dilute solutions there is no perceptible effect on the degree of flocculation. At a concentration of about 0.0005 gram per liter an increased flocculation

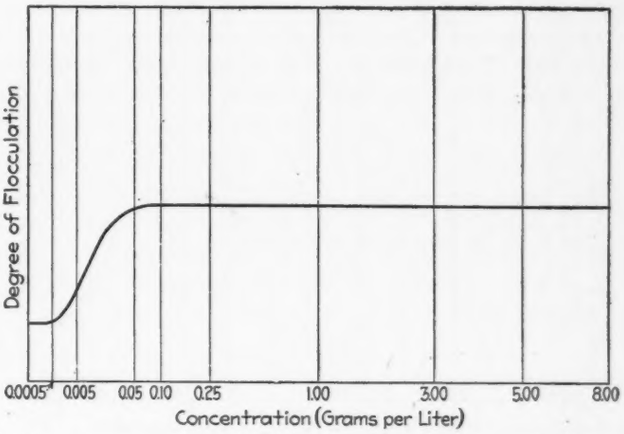

FIG. 2. FLOCCULATION OF KAOLIN SUSPENSIONS BY SODIUM CHLORIDE

begins to be perceptible, and this increases rather rapidly at first and then more slowly to a maximum at about 0.5 gram per liter, beyond which increases of cencentration produce no further perceptible effect on the degree of flocculation. The experiments were extended to saturation (250 grams per liter), but the corresponding portion of the curve is not shown in the figure.

This behavior is characteristic of nearly all soluble salts and acids acting on most suspended substances. The initial concentration at which an effect begins to be apparent is known as the threshold concentration and

[8]The essential facts of flocculation rest upon the work of numerous experimenters, going back to Scheerer, "Pogg. Ann." Ser. 2, Vol. LXXXII, pp. 419-29 (1851) and probably earlier. For details see the papers cited in the appended bibliography and also: Skey, "Chem. News," Vol. XVII, p. 160 (1868); Schloesing, "Comptes Rendus," Vol. XX, pp. 1345-8 (1870); Waldie, "Journ. Asiatic Soc. Bengal," Vol. XLII, Part II, pp. 210-26 (1873); Durham, "Chem. News," Vol. XXX, p. 57 (1874), "Proc. Edinb. Phys. Soc.," Vol. IV, pp. 46-50 (1878), "Proc. Roy. Soc. Edinb.," Vol. IX, pp. 537-41 (1878); Ramsay, "Quart. Journ. Geol. Soc.," Vol. XXXII, pp. 129-33 (1876); Mayer, "Forsch. Gebeit Agricultur-Physik," Vol. II, pp. 251-73 (1879); Schulze, "Pogg. Ann.," Ser. 2, Vol. CXXIX, pp. 366-83 (1866); Brewer, "Mem. Nat. Acad. Sci." (Wash.), Vol. II, pp. 163-75 (1884), "Amer. Jour. Sci.," Ser. 3, Vol. XXIX, pp. 1-5 (1885); Bodländer, "Neues Jahrb. Min.," 1893, Part II, pp. 147-68; Richards, "Ore Dressing," Vol. II, p. 1148 (1903); Hall and Morison, "Jour. Agric. Sci.," Vol. II, pp. 244-56 (1907); Hermann, "Zeits. Anorg. Chem.," Vol. LIII, pp. 413-18 (1907); Whitney and Straw, "Jour. Amer. Chem. Soc.," Vol. XXIX, pp. 325-9 (1907); Ehrenberg, "Kolloid Zeits.," Vol. III, pp. 196-206 (1908); Ashley, United States Geological Survey, "Bull." 388 (1909); "Min. and Sci. Press," Vol. XCVIII, pp. 831-2 (1909), United States Bureau of Standards, Tech. Pap. XXIII (1911); Puchner, "Landw. Vers. Stat.," Vol. XX, pp. 249-67 (1909); Rohland, "Kolloid Zeits.," Vol. XI, pp. 193-5 (1913).

varies considerably in suspensions of different materials and with different salts or acids. It is worth noting that, contrary to the current conception of the matter, this threshold concentration is not a sharp point at which the flocculation begins suddenly—like, for instance, the beginning of boiling at a definite temperature—but is rather a range of concentrations inside which the flocculating effect begins and rises more or less gradually to its maximum.

Flocculating and Deflocculating Agents

The different acids and salts vary greatly in flocculating power, but these variations have not been investigated with any considerable precision. Among typical colloids such as colloidal metals there are many cases in which the flocculating action of added salts appears to increase rapidly with rise in the valence of the flocculating ion. The salts of univalent elements are least active, those of bivalent elements somewhat more active, those of the trivalent elements still more active, and so on. However, there are many exceptions, and general application of the rule is not possible. Doubtless further investigation

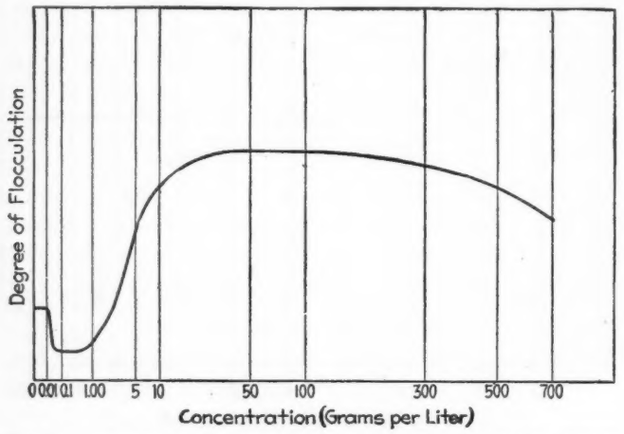

FIG. 3. EFFECT OF POTASSIUM HYDROXIDE ON FLOCCULATION OF KAOLIN SUSPENSIONS

will supply principles for the prediction of the flocculating powers of various salts, but at present these powers must be regarded as individual and specific. In the most tentative way one can say that the neutral salts of the alkali and alkaline-earth metals increase in flocculating power in the following order: Sodium, potassium, ammonium, magnesium, calcium and barium; the three latter being considerably more active than the three former. Also it appears probable that, among these salts, sulphates are usually more active than chlorides and less active than nitrates. These statements—they can scarcely be called conclusions—appear to apply fairly well to the flocculating effects of the salts mentioned on quartz, kaolin and other similar suspensions as well as on the colloidal solutions of metals. However, the manner in which different suspended substances respond to the same flocculating agent has received almost no quantitative investigation.

In solutions of the alkalies the relations are more complex. Fig. 3 gives the effect of potassium hydroxide on the degree of flocculation of kaolin suspensions as determined by F. K. Cameron and me.[9] It is apparent, as already noted, that the degree of flocculation in pure water is not zero, but is importantly greater than in some of the alkaline solutions. There is again the phenomenon of the threshold concentration, but when the threshold is passed, the effect is a decrease rather than an increase in the degree of flocculation and there is a zone of deflocculation reaching to a concentration of nearly 1 gram per liter. As concentration increases beyond this, there is an increased flocculation, surpassing at about 4 grams per liter the degree of flocculation attained in pure water and rising thenceforth to a maximum of flocculation at about 30 grams per liter. In greater concentrations there is a decrease which, however, may be in part merely apparent and due to increasing viscosity and density of the solutions. The characteristic deflocculating effect of alkali appears, therefore, as an effect over a certain concentration range only. At higher concentrations there is a flocculating effect not unlike that of the acids and neutral salts.

[9]Cameron and Free, "Science" (n. s.), Vol. XXXII, p. 482 (1910); Free, "Jour. Frank. Inst.," Vol. CLXIX, pp. 430-4 (1910).

Cottonwood-American Fork Mining Region

The Cottonwood-American Fork mining region, Utah, has produced over $20,000,000 worth of metals—silver and lead and smaller quantities of gold and copper. The region includes the Big Cottonwood, Little Cottonwood, American Fork and Alpine mining districts, in the central part of the Wasatch Mountains, just southwest of the Park City district.

Alta, the principal town, is about 20 mi. southeast of Salt Lake City. The region extends from the crest of the Wasatch Range to the edge of Salt Lake valley. The west base of the range stands about 5,000 ft. above sea level, and the highest summits reach altitudes of 11,500 ft. Heavy snowfall greatly interferes with winter operations, and since the timber was removed snowslides have been a menace to life and property.

Bulletin 620-I, by B. S. Butler, G. F. Loughlin and V. C. Heikes, just published by the United States Geological Survey, describes the geology and ore deposits of the region and gives a history of early mining and production in the region.

Reorganization of Patent Office

President Wilson signed the bill on Feb. 15, for a reorganization of the working force in the Patent Office, by means of which Patent Commissioner Thomas Ewing expects to greatly increase the efficiency of his staff by encouraging competent examiners to remain longer in the Government service. It has been a matter of common knowledge that for years the Patent Office has been a sort of Government training school for patent lawyers, who go into private practice or private employment at about the time their training has made them valuable.

Under the old organization of the office there have been 110 fourth assistant examiners, 88 third assistants, 73 second assistants and 63 first assistants. Under the new plan there will be 86 examiners in each grade, thus providing for promotions at a faster rate. The effect of the reorganization of the office under the new law will be to increase the average salary of assistant examiners from $1,880 to $1,950 per annum.

Analysis of Slate and Dike

By E. E. White*

SYNOPSIS—The difficulty of distinguishing between slate and dike has led to a search for chemical means for so doing, through comparison of analyses. It has been shown that such a method is practicable and of great assistance in studying and mapping the features of the Marquette Range.

In the hard-ore mines of the Marquette Range seams of slate and dike are common both in the iron formation and in the ore. In preparing geological maps it is necessary to differentiate between the slate and dike, not only so as to be able to record something definite on the map, but also to assist in connecting on the map seams encountered in drill holes and underground workings. The hard ore of the Marquette Range lies in the Negaunee iron formation of jasper, just under the unconformable Ishpeming formation of slate quartzite and conglomerate, also occurring in the conglomerate at the base of the Ishpeming formation. The geology of the hard-ore mines is complicated by folds, faults and the seams of slate and dike already mentioned, and it has been found that geological maps are of great assistance in finding ore and developing it at the least expense.

The Seams Vary in Thickness

The seams of dike and slate about which the difficulty arises vary from a few inches to 50 ft. or more in thickness and are so completely metamorphosed by pressure and shearing that in the hand specimen they sometimes cannot be told apart. The dikes are offshoots of a great diorite mass that underlies the hard-ore horizon and forms the main foot wall of the Cliffs Shaft mine, to which this article has particular reference. The seams of slate are probably all clastic dikes dropping down from the unconformable slate of the Ishpeming formation, which constitutes the hanging wall of the orebodies. It is certain that some of the seams are clastic dikes, since they cut across the banding of the jasper and since banding in the seams is approximately at right angles to the bounding walls of the fissure. In the case of most of the seams it cannot definitely be determined whether they are clastic dikes or bands of slate conformable with the jasper, but since we know that there are some clastic dikes, it seems probable that all are of this nature. The situation is further complicated by many fault zones that include seams of both dike and slate sheared together so as to make the determination of material impossible.

Not only is it often impossible to differentiate between the slate and dike in hand specimens, but it is often impossible to do so in thin sections. Both materials are so completely sheared and altered that they are merely a mass of sericite, and a thin section shows nothing of the original structure. Several years ago W. L. Scanlan, who was at the time assisting in the geological work at the Cliffs Shaft mine, suggested that we might differentiate between the slate and dike by analysis. This suggestion was followed up, and analyses of 6 known slates and 8 known dikes were made for alumina, silica, lime, iron, ferrous iron, loss by ignition and insoluble residue. We realized that the determination might better be made by analysis of the alkalies, but an ordinary mining laboratory is not fitted to make such determinations, and furthermore, they are expensive. The results of analyses for alumina, silica and lime did not help us, as slates and dikes both analyzed about the same. The analyses for iron, ferrous iron, loss by ignition and insoluble residue, however, showed a considerable difference, and starting from these analyses, a table of limits was built up which permits us to tell definitely whether a given sample is slate or dike.

TABLE 1. LIMITING VALUES OF VARIOUS ANALYSES AND FACTORS

	8 Sure Dikes Determined by Hand Specimens	6 Sure Slates Determined by Hand Specimens	41 Dikes Determined by Analysis	39 Slates Determined by Analysis
Loss by ignition.	5.37–15.55	2.44– 4.15	3.65–15.55	1.78– 4.30
Insoluble residue	40.48–60.40	75.84–92.00	28.35–71.80	20.90–92.00
Total iron.....	5.20–17.90	3.20– 8.40	3.60–27.60	2.30–45.10
Ferrous iron....	4.50–15.30	0.30– 2.50	2.30–23.60	0.30–13.30
Ferrous iron / Total iron	0.741– 0.889	0.077– 0.707	0.426– 0.937	0.015– 0.776
Insoluble residue + iron oxides.	55.05–74.87	84.63–96.40	55.05–83.29	83.40–96.40

In Table 1 it will be noticed that in the 14 sure slates and dikes first analyzed there was no overlap of any of the limits except in the case of total iron, which by itself is of no value as a determinative factor.

Result of Analyzing Large Number of Slates and Dikes

In analyzing large numbers of slates and dikes afterward, which could not be determined in the hand specimen, it became evident that the limits must be extended in most cases. This was done with care, one or more factors fixing the character of the rock by falling within the old limits and permitting the extension of the limits of other factors. When this was done, it was found that all the factors overlapped to a certain extent except insoluble residue plus iron oxides.

TABLE 2. DETERMINATIVE VALUE OF DIFFERENT ANALYSES AND FACTORS

	39 Slates		41 Dikes		80 Altogether	
Analysis	Number of Samples Within Slate Limits and Outside Dike Limits	Number of Samples Within Both Slate and Dike Limits	Number of Samples Within Dike Limits and Outside Slate Limits	Number of Samples Within Both Dike and Slate Limits	Number of Samples Within Limit of One Material Only	Number of Samples Within Limits of Both Slate and Dike
Loss by ignition....	32	7	36	5	68	12
Insoluble residue...	27	12	0	41	27	53
Total iron..	8	31	0	41	8	72
Ferrous iron	16	23	15	26	31	49
Ferrous iron / Total iron	28	11	21	20	49	31
Insoluble residue + iron oxides.....	39	0	41	0	80	0

From Table 2 it is evident that insoluble residue plus iron oxides is the best determinative factor, although the analyses of insoluble residue, total iron or ferrous iron taken by themselves mean very little. Loss by ignition and the ratio of ferrous iron to total iron are often definitely determinative and make a good check on insoluble residue plus iron oxides. If any one of these three factors indicates a different material from the other two, the sample is considered indeterminate, but this only happened in three samples out of 83 analyzed.

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Table 3 shows that all three factors of most samples fall definitely within either slate or dike limits. The three factors used are: Loss by ignition, $\frac{Fe''}{Fe}$ and insoluble residue plus iron oxides.

TABLE 3. DEFINITE SLATE AND DIKE LIMITS

Number of Samples	Per Cent.	Number of Factors in Each Sample Within Slate Limits and Outside of Dike Limits	Number of Factors in Each Sample Within Both Slate and Dike Limits	Number of Factors in Each Sample Within Dike Limits and Outside of Slate Limits
24	61.5	3	0	0
11	28.2	2	1	0
4	10.3	1	2	0
Total slates. 39	100	..	..	..
5	12.2	0	2	1
15	36.6	0	1	2
21	51.2	0	0	3
Total dikes. 41	100	..	..	..
1	....	2	0	1
1	....	1	0	2
1	....	1	1	1
Total doubtful..... 3	....	..	..	..

In other words, out of 83 samples, 45, or 54.2%, were definitely determined by all three factors; 26, or 31.3%, were definitely determined by two factors, the other factor being indeterminate; 9, or 10.9%, were definitely determined by only one factor, the other two factors being indeterminate; and only 3 samples, or 3.6%, were doubtful because of conflicting factors.

In brief, the dikes are characterized by high loss through ignition, high ratio of ferrous iron to total iron and low insoluble residue plus iron oxides. The slates are characterized by low loss by ignition, low ratio of ferrous iron to total iron and high insoluble residue plus iron oxides. The insoluble residue alone does not mean much, although the dikes never seem to get above 71.80%, while the slates run up to 92%. The difficulty is, however, that when there is much iron present in the slates, it forms such a large percentage of the whole that the insoluble residue is reduced to a very small quantity. It is therefore necessary to add the percentage of iron oxides in order to get a figure that can be compared with the analyses of dike. Having the total iron and ferrous iron determined, it is comparatively simple to find the amount of ferric iron by subtraction and the percentages of ferrous oxide and ferric oxide by multiplication of the iron percentages by 1.285 and 1.429 respectively. Considering that the iron oxides replace the soluble parts of the rock, as well as, or perhaps even more than, the insoluble parts, and also that the iron oxides are of greater specific gravity than the parts they replace, it might seem, theoretically, that insoluble plus iron would give better results for comparison than insoluble plus iron oxides. This does not seem to work out, however, as in the case of slates heavily charged with iron the insoluble residue plus iron falls within the dike limits, whereas with insoluble residue plus oxides there is no overlap.

Insoluble residue is determined by digesting with hydrochloric acid and evaporating to dryness twice, then adding more hydrochloric acid, filtering, washing and weighing the insoluble residue. It consists mainly of silica, with some aluminum silicate. The loss by ignition must consist mainly of water, organic matter and carbon dioxide, and I presume that it is largely the carbon dioxide which makes this factor higher in the dikes than in the slates. Very often the dikes are so calcareous as to effervesce with dilute acid.

This may be characterized as a rule-of-thumb method, but I think the tables show that it will differentiate between the slates and dikes in this particular case. Each mine or locality must be taken as a unit and new tables of limits prepared by analyzing known samples. When it is essential that the determination be made and when the microscopic examination of thin sections fails, I believe that this method is worth consideration. Complete results of the 83 analyses mentioned in this article are given in Table 4.

TABLE 4. COMPLETE RESULTS OF 83 ANALYSES

Loss	Insoluble	Fe	Fe′	Fe″	Insoluble + Iron Oxides
Eight Sure Dikes, Determined by Hand-Specimens					
8.67	53.46	9.0	7.70	0.855	65.22
15.55	54.60	5.20	4.50	0.865	61.38
5.40	60.40	11.00	8.70	0.790	74.87
6.85	40.48	17.90	15.30	0.855	63.86
5.68	50.80	15.20	13.50	0.889	70.58
13.88	42.36	9.60	7.10	0.741	55.05
5.37	51.76	16.40	12.40	0.758	73.41
9.31	51.75	8.60	6.70	0.780	63.08
33 Dikes, Determined by Analysis					
8.78	69.75	3.60	2.30	0.639	74.57
6.23	31.50	25.70	23.60	0.919	64.83
4.41	69.40	8.90	5.80	0.652	81.29
5.13	49.60	15.70	13.60	0.866	70.08
5.11	59.50	12.80	9.80	0.766	76.38
5.85	64.00	9.80	8.10	0.827	76.83
4.10	54.40	21.40	11.80	0.552	83.29
5.82	49.60	16.60	14.40	0.868	71.24
4.40	59.40	13.50	9.90	0.733	77.28
5.97	41.40	19.20	15.00	0.782	66.68
5.05	46.94	20.60	16.70	0.811	73.97
6.53	47.80	15.90	9.60	0.603	69.14
5.94	49.76	18.00	8.40	0.467	74.28
14.17	52.25	7.30	5.00	0.685	61.97
10.10	55.34	12.20	5.20	0.426	72.02
4.61	45.15	22.60	19.40	0.859	74.65
15.38	49.16	9.20	5.00	0.543	61.59
5.68	52.20	14.10	11.50	0.815	70.70
5.84	49.94	14.40	13.00	0.903	68.64
9.70	45.65	17.80	10.20	0.573	69.60
9.42	54.60	11.60	5.90	0.508	70.33
6.33	28.35	27.60	22.70	0.822	64.53
3.95	69.45	8.70	4.90	0.563	81.18
6.95	34.27	20.60	19.30	0.937	60.93
3.69	66.04	12.80	7.40	0.578	83.28
5.83	40.60	20.20	18.00	0.891	66.86
5.50	41.96	20.50	17.00	0.830	68.81
5.93	42.90	18.70	15.80	0.845	67.34
4.38	71.80	8.70	6.60	0.759	83.28
4.23	53.97	20.30	11.10	0.547	81.39
5.35	49.50	15.60	13.50	0.866	69.85
8.75	61.35	7.50	5.70	0.760	71.25
3.65	55.30	20.60	13.60	0.661	82.78
Six Sure Slates, Determined by Hand-Specimens					
3.35	75.84	8.20	2.50	0.305	87.20
2.44	80.21	8.40	1.70	0.203	91.98
3.29	87.44	3.40	2.40	0.707	91.95
3.07	88.20	3.90	0.30	0.077	93.74
4.15	75.84	6.40	2.50	0.391	84.63
3.20	92.00	3.20	1.20	0.375	96.40
33 Slates, Determined by Analysis					
3.03	77.80	7.80	4.60	0.590	88.29
3.00	67.95	19.40	0.30	0.015	95.64
2.31	91.14	2.60	0.40	0.154	94.79
4.30	74.20	8.10	4.10	0.506	85.19
2.83	76.44	10.80	3.40	0.315	91.38
2.60	85.64	6.40	0.40	0.062	94.73
3.07	70.90	13.10	5.20	0.397	88.86
3.33	70.20	15.00	4.50	0.300	90.98
2.40	85.40	4.90	1.50	0.306	92.19
2.80	79.85	5.80	4.50	0.776	87.49
2.90	87.35	4.10	0.70	0.171	93.11
2.91	88.80	2.40	1.00	0.417	92.09
2.52	73.95	13.10	5.00	0.382	91.95
1.78	72.90	11.70	5.70	0.487	88.81
2.37	77.40	10.80	4.60	0.426	92.17
3.85	78.52	9.30	1.20	0.129	91.63
3.45	87.25	2.60	0.60	0.231	90.88
2.95	63.49	19.30	2.30	0.119	90.75
2.82	58.80	22.10	1.90	0.086	90.14
3.58	87.90	2.30	1.00	0.435	91.05
4.02	72.79	9.50	6.40	0.674	85.45
3.07	68.25	15.80	6.00	0.380	89.96
4.09	72.79	9.30	6.50	0.699	85.15
2.68	77.39	11.50	3.30	0.287	93.35
3.67	83.25	5.70	1.50	0.263	91.19
3.00	73.40	11.90	6.20	0.521	89.52
2.43	60.40	23.70	7.90	0.334	93.15
1.98	66.32	19.50	3.00	0.154	93.78
3.05	64.74	18.60	1.00	0.054	91.18
4.20	79.02	7.50	3.30	0.440	89.27
1.90	48.80	31.00	10.30	0.333	91.63
2.72	20.90	45.10	13.30	0.295	83.40
3.29	65.67	13.60	6.50	0.477	84.23
Three Doubtful Samples Out of a Total of 83					
4.38	63.55	13.90	3.80	0.287	82.86
4.78	74.55	7.10	4.30	0.606	84.08
6.87	47.77	26.00	1.50	0.058	84.70

The 112th A. I. M. E. Meeting

The 112th meeting of the American Institute of Mining Engineers, held in New York from Feb. 14 to Feb. 17, was one of the most successful in the history of the Institute. The attendance of members was the largest, as was also the number of ladies present, and the entertainment provided both for members and their wives proved most acceptable. The entertainment committee, headed by Thomas T. Read, owing to the illness of Mr. Addicks, was ably assisted by Mrs. L. D. Huntoon's committee, which took charge of the entertainment of the visiting ladies. The luncheons served daily at the Engineering Societies' Building were more largely attended than ever before, these occasions being enlivened by the greater number of ladies present this year. The luncheons were further enlivened by *The Daily Fume,* announced in true "Wuxtry" style by Secretary Stoughton's $1 newsboy; it covered in a lighter vein the "important" features of the Institute meeting and revealed some remarkable information about the youth of some of the Institute's officers.

The technical sessions were begun on Monday morning, Feb. 14, with the petroleum and gas division, and the afternoon was devoted to simultaneous meetings in different halls by the divisions of geology and coal and coke. Two to three technical sessions covering various phases of mining and metallurgical practice were held each day except on Thursday, when the entire day was given up to excursions.

College reunions were held on Monday evening at various clubs in town, the Columbia School of Mines having the largest meeting of this character. Following the college dinners, many of the members attended the first of the series of military lectures arranged for engineers by the joint committee of the national engineering societies. So much interest was taken in the matter of preparedness for engineers that this meeting and an "overflow" lecture by another army engineer were not able to accommodate all who desired to learn what the engineer would be expected to do in the event of war.

At the annual business meeting on Tuesday morning, the election of officers for the ensuing year resulted in the selection of Dr. L. D. Ricketts as president; Sidney J. Jennings, first vice-president; Karl Eilers and James McNaughton, vice-presidents for three years; Joseph W. Richards, vice-president for one year; George C. Stone, treasurer; Bradley Stoughton, secretary; directors for three years, George D. Barron, Charles W. Goodale, Edwin Ludlow, Charles F. Rand and Thomas B. Stearns. The amendment to raise the annual dues of members to $12 was reported carried. The autumn meeting will be held in Arizona in the latter part of September, and a week will probably be spent in visiting the various mining districts.

On Tuesday evening, the smoker was held at the Aldine Club and proved fully as entertaining as expected, the principal feature being the flotation travesty, a portion of which was reproduced in a preceding issue of the *Journal.* The dinner at the Hotel Astor on Wednesday evening was attended by 358, the largest number ever present at this function; about one-third of the diners were ladies, this year, the attendance evidently being stimulated by the announcement that dancing would follow the banquet. On Thursday there were no technical sessions, the day being given over to a "Preparedness" excursion including a visit to the Brooklyn navy yard and an examination of the New York harbor defenses; the U. S. S. "Dolphin" was loaned for this purpose, and the directors of all the national engineering societies joined in the inspection.

The success of the Institute meeting was to a large extent the result of the careful planning of the committee on arrangements, headed by David H. Browne. It is worthy of note that these results were all accomplished within the budgets requested by the subcommittees. The finance committee has funds to return to the underwriters, and stranger still, the committee on arrangements received this year letters of congratulation and appreciation of the work done. Visiting members were especially appreciative of the entertainment provided for their wives during the technical sessions by the ladies committee and will probably feel no hesitancy about "bringing the family" to future meetings in New York.

Present State and Aims of the A. I. M. E.*

The Institute is at present in sound condition professionally and financially. During the last year 516 new members were elected, the total membership at the present time being 5,221. The treasurer's report shows that the Institute's expenses are met by its income. Your directors have thought wise to issue to the members a referendum asking for a vote upon the suggestion that the annual dues be raised from $10 to $12. This moderate increase is proposed not because the Institute needs it at present, but to insure a continuation and increase in its activities and usefulness and to provide a reserve fund for future emergencies. In well-conducted organizations such as clubs, it is a wise and safe course to so adjust the dues of members that the total receipts from this source will about equal the annual expenditure, the initiation fees being used for reserve purposes. Our dues alone do not at present meet the expenses. This, I think, is the whole situation so far as this question is concerned. Expenses might be reduced in some measure, but they cannot be materially diminished without affecting the integrity and usefulness of your Institute.

Nothing of consequence in our internal affairs has occurred during the past year, except, perhaps, the establishment of an Arizona section and the prospect now assured of a Nevada section.

Relation of Institute to Other Societies

There has been during recent months a marked change in the relations of the Institute to its fellow societies and to the Government of the United States. That change is one of coöperation. The Secretary of the Navy has appointed two[1] of your members to the Naval Consulting Board to coöperate with members of 10 other scientific organizations. This board is now organized, and through its work your Institute is brought in close touch with the activities of the other societies and with the United States Navy. The President of the United States has requested us to recommend to the Government one of our representatives in each state in the Union to act in

*Address of the president, W. L. Saunders, American Institute of Mining Engineers, annual meeting, New York, Tuesday, Feb. 15, 1916.

[1]Seven members of the Naval Consulting Board are members of the Institute, but, except these two, were appointed as representatives of other national engineering societies.—Editor.

collaboration with a member in each state from the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Chemical Society, thus organizing a directorate of engineers for each state, who will conduct, through the members of each of the five societies referred to, living in each state, a campaign of industrial preparedness.

No more important step, it seems to me, has been made in the history of your Institute than this. The work which these 48 boards are expected to do will be directed by a committee of the Naval Consulting Board, and the far-reaching effect and usefulness of this work can hardly be overestimated. We hear a great deal about preparedness. Many plans have been suggested for increases in the army and navy of the United States, and much difference of opinion exists on the subject. As far as I have observed there is no difference of opinion on the question of industrial preparedness, which means a coördination and coöperation with the Government of our mines, mills, works and factories, so that in the event of trouble they may be in a position to respond promptly, energetically and with full force to the needs of the nation. Even as a peace measure such an organization is desirable. This country is the largest nation in the world industrially, yet our industries are working more or less at cross purposes, are not in touch with each other or with the Government. Such contact as has existed in the past between business and Government is a special, not a general, contact. Certain industries have had the ear of the Government, while others have not. Nor is the Government at present in a position to feel the pulse of the great industrial strength of the United States in peace or war. In this and in many ways a general contact will not only be beneficial to the Government, but it should prove of wholesome advantage to our American industries.

The Engineer's Duty in Preparedness

The engineer has been called upon to take this important step. Who is better fitted to do it and to do it well? Mind you it is not the mining engineer alone, but the civil, the mechanical, the electrical and the chemical engineer, coöperating as a unit. We have heard a great deal about the desirability of coöperation among engineers, but so far it has been mainly academic. Here we have a practical fulfillment of our desires and an opportunity the importance of which can scarcely be measured. It is no less important to the engineer and to the whole profession he represents than it is to the industrial strength and prosperity of the nation. The engineer is essentially a man of action, an executive, an administrator, and not a mere scientific worker operating behind closed walls in a dusty laboratory or over a drawing board. His place is out in the middle of the road with his coat off, leading men and initiating and directing measures of usefulness to the whole people.

We have heard our profession defined as one which uncovers the hidden forces of nature and puts them at the service of mankind. We have done a good deal in the line of uncovering these hidden forces, but have been very slow in our activitites toward placing the things revealed into useful operation. Modesty is not only a characteristic, but a fault among engineers. Some consider it undignified to get what they call notoriety, but it seems to me that there is a difference between notoriety and reputation, and the way to get reputation is to do things, not under a bushel but in the light, so that the world may know it and that the full measure of benefit may be derived by inspiring public confidence, not alone in what has been achieved, but in the personality of the individual who is responsible for the achievement.

Your Institute, like other long-established scientific bodies, has an integrity beyond reproach. It does not work for money, but for scientific advancement. Let its usefulness be extended to broader fields, and let us resolve to make this organization, which has now been called for by the President of the United States, a useful and permanent force in our whole national life.

Newfoundland Oil Shales

According to Harold C. E. Spence, who recently made a study of the oil-shale fields of Newfoundland and eastern Canada, "In Newfoundland and parts of eastern Canada some billions of tons of payable oil shales are assured, and some hundreds of millions of tons are known to contain a far greater percentage of oil to the ton than the shales of the successfully operated Scotch fields. There is therefore a reasonable hope of a very important industry being inaugurated in the extraction and the refining of oil and byproducts from these shales in the near future.

As reported by the *Iron and Coal Trades Review,* the shale-bearing areas appear to be largely confined to the eastern provinces. In New Brunswick there is no doubt as to the existence of shale fields that could be profitably worked. Several specimens of these shale deposits have been analyzed. In some cases the yield of oil to the ton has been as high as 40 gal., while an average of 30 gal. to the ton has been extracted from several deposits that are commercially workable. The shales of New Brunswick are of two distinct types: One is known as "paper shale" and appears in extremely thin formation; the other occurs in solid bodies and almost black masses, possessing elasticity. This variety gives about 55 lb. of ammonium sulphate to the ton of shale. Some of these beds as they occur are of an enormous thickness.

South Dakota Mineral Output in 1915

The annual report of the South Dakota State Mine Inspector shows a production in 1915 of 1,889,876 tons of gold ore, of which Homestake produced 1,573,822 tons; Wasp No. 2, 111,300; Trojan, 79,903; Golden Reward, 58,837; Mogul, 37,419; New Reliance, 27,645 and miscellaneous, 950 tons.

The tungsten-ore production was 218 tons, of which Wasp No. 2 produced 187 tons. Other minerals were: Gypsum, 12,293 tons; coal, 9,473; mica, 409; lithia, 256; tin ore, 43 and lead ore 2¾ tons. There were 2,931 persons employed.

Coeur d'Alene Production

According to the report of Robert N. Bell, state inspector of mines for Idaho, the production of lead during 1915 amounted to a gross total of 350,000,000 lb. Since the discovery of the district 32 years ago, the total production of lead, together with zinc, copper and gold, has been $300,000,000 gross value.

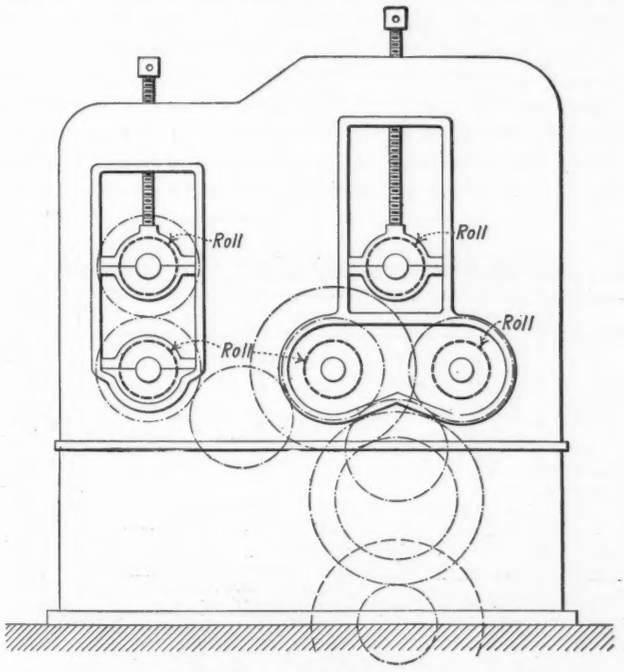
Details of Practical Mining

Straightening Mine Rails

By C. Carleton Semple*

Bent and twisted mine rails are readily straightened in the shops of the Tonopah Mining Co., at Tonopah, Nev., using a set of small rolls that are diagrammatically illustrated in the accompanying sketch, in which are shown the side views. One shows the relative arrangement of the five rolls, the other a diagram of the gearing which drives the rolls, the lowest pinion being mounted on the pulley shaft. The inner space between the sides measures about 8 in.

The rolls are time-saving devices, enabling a large number of rails to be straightened in a small fraction of the



ROLLS FOR STRAIGHTENING MINE RAILS

time that would be required to do the work by hand, and at the same time the rolls give much better results, bringing the rails nearer to perfect straightness than would be possible by hand-work.

In any mine where quantities of rails are taken up and relaid, such a device soon pays the cost of its installation. At the Tonopah-Belmont, rail-straightening rolls are to be used in the near future, but will probably differ somewhat in design from those here illustrated.

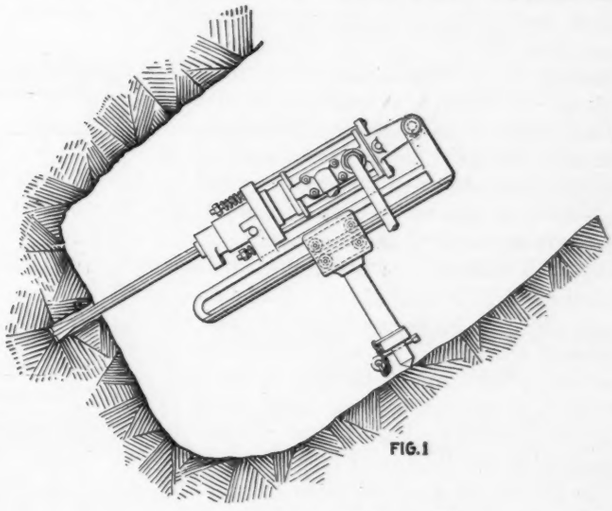
Whistles as Warning Signals

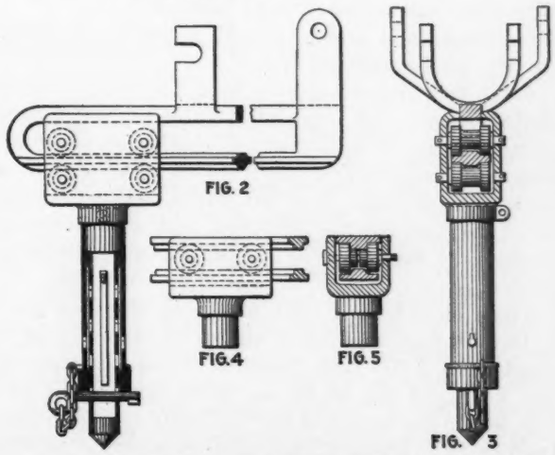
The crossings over electric haulage tracks in mine workings are especially dangerous on account of the fact that it is generally impossible to get a view of an approaching train from any crosscut or drift which crosses or joins the haulageway. Reliance for warning must therefore be placed on a bell or some other sounding device on the train.

Duncan Stewart, a motorman on the 2,000-ft. level of the Leonard mine, at Butte, recently conceived the idea of using a fireman's whistle for this purpose. It has proved a very distinct improvement over the use of the motor bells and all motormen in the mine have now been supplied with these whistles.—*The Anode.*

Mounting for Hammer Drills

A United States patent, No. 1,160,672, Nov. 16, 1915, has been granted to O. S. Tonnesen, of Johannesburg, Transvaal, South Africa, for a mounting for rock drills, more particularly of the hammer type. The object of the invention is to provide a supporting means for such drills, particularly adapted for drilling holes in the ends of rock cuts where there is a small amount of headroom, such holes generally being substantially in line with the floor of the cut, this supporting means being so constructed as to relieve the operator from the weight of the





DETAIL AND GENERAL ARRANGEMENT OF HAMMER-DRILL MOUNTING

*Mining engineer, Stamford, Conn.

drill and to be easily manipulated and placed in position. Fig. 1 shows a side elevation of a drill equipped with the mounting; Fig. 2 shows a side elevation, partly in section, of the mounting without the drill. The leg, or support, consists of the pointed rod which rests on the ground and an outside tubular member which telescopes over it and can be adjusted at the proper height by means of a small pin placed in holes drilled in the main leg.

The mounting has a sliding carriage moving in grooves in the head of the main support. When the drill is mounted in this carriage, there is thus a travel provided in the direction of the axis of the hole, which permits of the feed as usual.

The Keyboard Method of Shaft Timbering

By Atha. A. Richie*

During the last few years there has been quite a revolution in the method of shaft timbering compared with that which had been practiced formerly.

The following is a brief description of the cinch-block keyboard method that is being adopted in a great many of the Western mining camps, including Butte, Tonopah, Goldfield and the copper camps of Arizona.

After the set has been screwed up tight against the posts, the supports marked *A* in the figure are nailed onto the bottom of side and end plates to support keyboards until they are wedged, after which they are knocked off, as they are of no further use. The keyboard is then placed on top of supports, and the set is ready to be blocked. The cinch, or tenon blocks—they are usually called by the former name—should be nailed to the side and end plates before the timbers are lowered into the mine, and if 12x12 timbers are used, the cinch blocks should be 2x12x12 in. The outside blocks between keyboard and ground are wedged enough to hold the set in place, and then four wedges should be started between each cinch block and the keyboard. Two of the wedges should be started from the bottom of the set and two from the top, after which the outside blocks between the keyboard and ground should be pretty well tightened and the set brought to line.

After the timbers are in line, the wedges that were started between the cinch blocks and keyboard should be driven till the set is as tight as considered necessary, the lines being watched carefully to see that the set is not blocked out of line. The last wedges driven should open the space between the keyboard and wall plate enough so that the lagging will go in the space without any trouble.

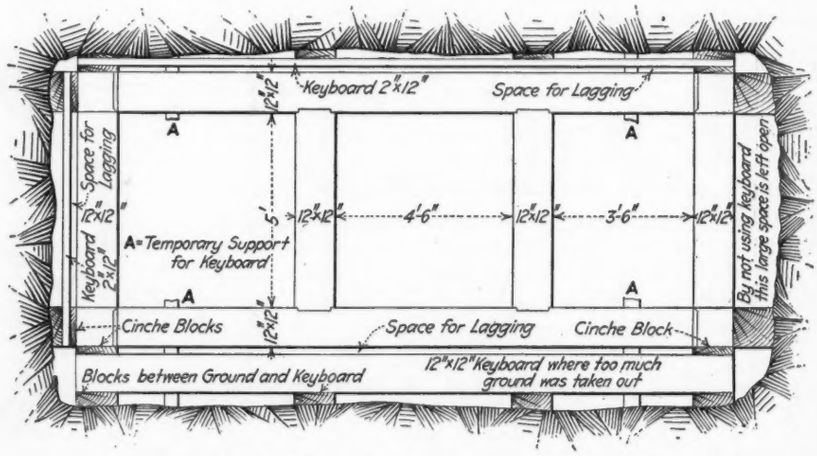
There should be a cleat nailed on the wall plates, as in the ordinary method of timbering, for the lagging to stand on. This cleat, however, should not extend the full length of the plates, as there should be a space of 2 ft. left in the center of the side plate to put the last two lagging in. There should also be a space of one foot left on the end of the end plate, through which to put the last lagging.

The first lagging can be put in place by tilting it sideways and then straightening it up until it stands vertical. In order to put the last lagging in there should be 6 ft. of ground out beneath the set. The lagging is then easily slipped up from beneath the set.

In order to keep the last lagging from falling out, a wedge can usually be driven down between the lagging and keyboard by reaching up behind the set, or it can be driven up and then cut off so that it will not interfere with the lagging of the next set.

This method requires no extra blocking and wedges for lagging, as they are fastened with the same blocks that line the set. Another advantage of this system is that there are no blocks in the center of the lagging. It is also a faster and more secure method than others.

Where too much ground has come out, which is frequently the case, as shown in the figure, a large keyboard can be put in that will catch up the ground and act as a bulkhead to keep rock from falling down from behind the set. The drawing also shows one end blocked as in the old method. The large open space would have been filled mostly by using a 6x12 keyboard. Had this place been left open and the lagging blocked with separate blocking above, as in the old method of timbering, there would have been a good chance to shoot it out. As there is so much spring to the lagging, it is very hard to block it securely when there is so much ground out. The length of the corner block will also be cut down by the thickness of the keyboard plus the thickness of the lagging. All miners know how much easier it is to put in a small block securely than it is a large one.



PLAN OF SHAFT TIMBERING, SHOWING USE OF KEYBOARD

In a large shaft, as shown in the figure, the side keyboard would have to come down in two pieces in order to get it in place. The joint should come at one of the dividers, and the temporary supporting cleat should come to the joint so that it may hold one end of each piece of the keyboard; otherwise, it will require another support.

The holes in wall plates as shown in the sketch are for the hanging rods.

The temporary supports marked *A* in the figure, may be made of any sticks such as 2x4; wedges would serve, and in fact are frequently used where the keyboard is but 2 in. thick.

*P. O. Box 931, Tonopah, Nev.

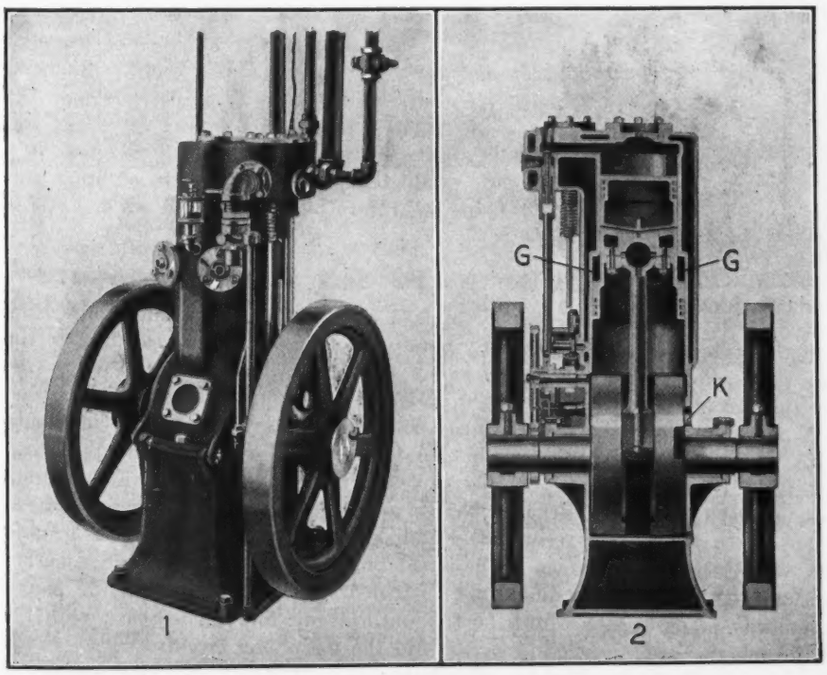
Portable Gasoline-Driven Air Compressor

A compact portable self-contained two-stage vertical gasoline-driven air compressor (Fig. 1), which is proving reliable and efficient, and is inexpensive, has been put on the market by the Lyons Atlas Co., of Indianapolis, Ind. It is made in sizes of from 35 to 150 cu.ft. capacity per minute for pressures up to 200 lb. per sq.in.

The engine is a 4-cycle single-acting vertical gas engine combined in a single unit with a two-stage direct-driven air compressor, the power cylinder and its accompanying air cylinder consisting of one continuous casting, requiring only a single differential piston. Only a few more parts are employed in the complete combined unit than are necessary in either an engine or a compressor alone of the usual independent type. The machine may be started either by hand or by air previously compressed.

The operation of the machine can be seen by referring to Fig. 2. When the air piston is at the top of its stroke, the crank case is full of air at atmospheric pressure, admitted through port *K*, which registers with a port in the nearest crank disk. On the downward stroke this air is compressed in the crank case, thence flowing into the annular chamber *G*, raising the absolute pressure therein to approximately 20 lb. The valve in this passageway closes as the piston starts on the upward stroke, and as soon as the pressure in the annular space *G* reaches the receiver pressure, the discharge valve *H* opens, allowing the air to pass into the receiver during the remainder of the upward stroke. Since the pressure in the crank case assists the piston on the upward stroke and the location of the port in the crank disk is such as not to open port *K* until atmospheric pressure is reached, no work is lost; and high efficiency is secured.

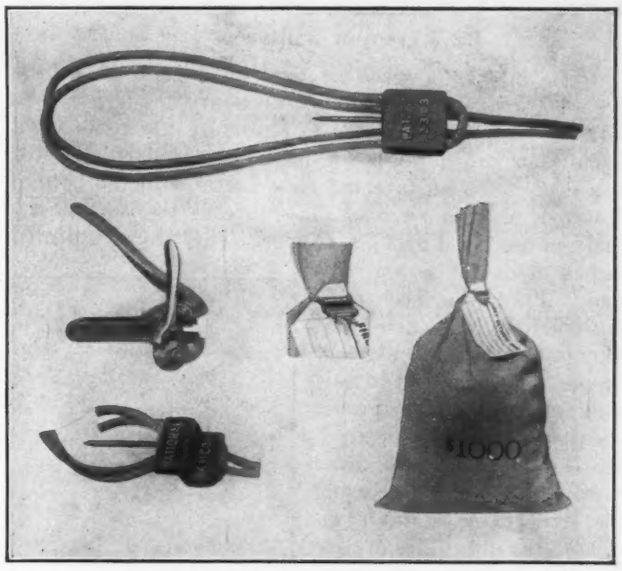
The power end is regularly designed for the use of gasoline, because of its universal availability, but it can be arranged easily for the use of kerosene or for gas—either natural, illuminating or producer.



ELEVATION AND SECTION OF SELF-CONTAINED GASOLINE-DRIVEN AIR COMPRESSOR

Seals for Mine Samples

A seal that seals, and has stood the test of 12 years' service by the Treasury Department of the United States, as well as by thousands of banks, the leading express companies and numerous mining concerns, is manufactured by the Porter Safety Seal Co., of 1112 W. Lake St., Chicago, Ill. It is shown in sufficient detail in the accompanying illustration, so that no description is necessary. These seals seem to deserve a wider use among engineers that have large numbers of mine samples to seal, inasmuch as they are quickly adjusted and are absolutely proof against tampering, as the seal cannot be removed and replaced without detection. Unfortunately this is a desideratum that cannot be overlooked and on which, many times, large amounts of money depend.



A SAFE SEAL FOR MINE SAMPLES

Frasch Sulphur-Mining Patent

About two years before his death, the late Herman Frasch, of the Union Sulphur Co., applied for another patent supplementing his method of mining sulphur by melting with superheated water and pumping the sulphur to the surface while still in molten condition.

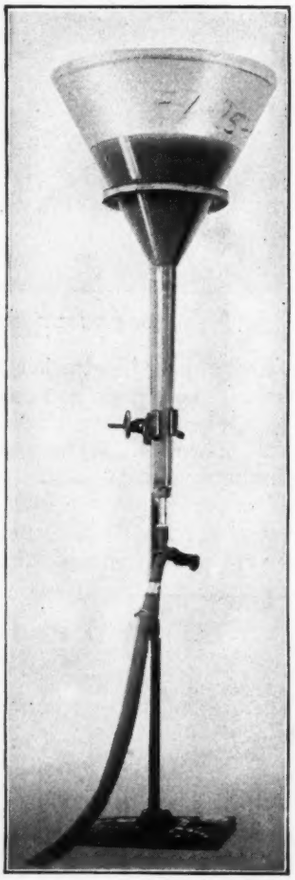
The present invention (U. S. Pat. 1,152,499) relates more particularly to the use of a water-withdrawing well placed in a water-flooded porous deposit at some distance from the area where the fusion fluid is being introduced. The withdrawing well or wells are intended to remove water of a temperature below the melting point of the sulphur and thus facilitate the introduction of the fusion fluid—superheated water, about 35° F. above the melting point of sulphur. A large saving in "steaming" expense and increased sulphur production are attained.

Details of Milling and Smelting

Laboratory Cyaniding Agitator

By Raymond B. Ladoo*

While making a series of tests on a gold ore by the cyanide process, it was found necessary to devise some form of laboratory agitator to reproduce the action of a Pachuca or Brown tank on a small scale. A small agitator was made from an inverted glass bottle with the bottom removed, using a piece of glass tube as the central air-shaft, as described by T. S. Lawlor.[1] This proved unsuited to our needs for several reasons: First, the mechanical construction was not easy, owing to the difficulty of supporting the central air column in just the proper position; second, too much ore had to be used to make it work at all, and decreasing the size of the agitator increased the difficulties of construction; third, the slope from the body of the bottle toward the neck was not sufficient to cause the ore to slide freely, and dead corners resulted. The agitator described here overcame these difficulties.



A LABORATORY AGITATOR

An ordinary glass funnel about 7 in. in diameter with a stem about 8 in. long by ⅜ in. inside diameter formed the body of the agitator. A piece of rubber tubing about an inch long and just large enough to fit snugly was forced inside the lower end of the funnel stem. This served as a rubber stopper, into which a piece of glass tubing about 2 in. long was pushed until its end was just flush with the inside end of the rubber stopper. To the other end of this tube was attached a short piece of rubber tubing, then another short length of glass tubing, to which the tube from the compressed-air jet could be attached. A screw clamp was placed on the short rubber tube. To prevent any possible leakage of either air or solution at the connections between the glass and rubber tubes, a coating of paraffin was applied to each junction.

The funnel was then suspended in a ring-stand, the air tube attached, and it was ready for operation. To start it, part of the cyanide solution to be used was poured into the funnel, the air turned on slowly and the ore added. Then the remainder of the solution was added, the air pressure increased and turned on more fully and regulated so that there was a vigorous agitation of the pulp without spattering. A large watch-glass was inverted over the top of the funnel to prevent loss of pulp should the air pressure from lack of proper regulation increase and produce too violent agitation. It was found that if the air was turned off entirely, the pulp, instead of escaping through the air-delivery tube as might be expected, immediately blocked the small glass tube at the bottom of the funnel and completely prevented the escape of either solution or pulp. In most cases, if the air pressure became too strong, the air-delivery tube would blow off the glass tube to which it was attached and so automatically stop the agitation before any pulp could be thrown out of the funnel. In this way both too strong and too weak air pressures were provided for. The small glass tube between screw clamp and the air tube served as a sort of gage-glass through which could be detected any escape of solution when the air pressure was turned off, should the pulp fail to block the tube. The air pressure used fluctuated somewhat, but never exceeded 10 lb. per sq.in.

In this form of agitator it was found possible to agitate thoroughly material as coarse as 90-mesh (0.18 mm.) in as large quantities as 100 grams, using pulp ratios of from 5 to 10 of solution to 1 of ore, by weight. Material as coarse as 28-mesh (0.53 mm.) was tried, but it was found that the large particles immediately dropped into the long stem and formed a compact mass, which the entering air channeled but did not lift.

The action of this agitator resembles that of a hydraulic classifier in that the particles of ore slide down the sloping sides of the funnel and part way into the stem, where they are met by the rising current of air and solution and thrown out again into the comparatively quiet zone above, only to repeat the same cycle. Thus the whole of the charge is constantly given a thorough agitation and aëration. Since in practical work only material much finer than 90-mesh would be agitated, this form of apparatus proved ideal for laboratory tests on a small scale.

*Harvard Mining School, Cambridge, Mass.

[1] "More Recent Cyanide Practice," p. 290.

Substitute for Lead Acetate

The supply of lead acetate for Australian mines came from Germany before the war outbreak, according to the *Monthly Journal* of the Chamber of Mines of West Australia, Sept. 30, 1915. Consequently the supply has been short, and it has become necessary to provide some substitute for the chemical for use in cyanide plants. Lead nitrate has been tried, after a suggestion from the Rand, but litharge has been generally adopted as more convenient, economical and satisfactory. The litharge is ground in a pan at the Great Boulder Perseverance mine, together with quicklime, in which it is soluble. From the pan it flows into the tube-mill circuit and thence back with the unground sands into the main pan circuit.

The use of litharge as a substitute for lead acetate to remove soluble sulphides from cyanide solutions is not

new, since it has been used in Canada, the United States and Mexico, even in normal times, as a measure of economy. It is usually fed directly into the tube mill, where it is readily ground and put into solution. Assay cupels have often been thus ground so as to utilize the litharge contained.

Milling Low-Grade Zinc Ore

By L. L. Wittich*

With a capacity of 600 tons of ore per 10 hr., the Media mill at Webb City, Mo., is enabled to operate profitably on material that yields barely more than 2% zinc sulphide, and this in turn assays about 59% zinc, with only a trace of lead and iron. The plant is one of the largest in the Missouri-Kansas-Oklahoma district, being about equal in capacity to the Klondike mill, operated by the Granby Mining and Smelting Co., at Granby, Mo. Sheet ore is mined at the Media from a depth of 230 ft. with ore faces 9 ft. in height. Formerly the tract was mined to some extent by the Holdout Mining Co., which, however, operated a smaller mill and could not work successfully at the lower prices then prevailing.

Balanced skips, instead of the old-style "cans," are used at the Media for hoisting. There is also a compartment, 6 ft. by 16 in., for air and pump lines. The capacity of each skip is 5,000 lb., and a first-motion Keck-Gonnerman hoist is used. The ore empties onto double grizzlies through which it passes into a 1,000-ton hopper, the largest in the district. The chief frame construction is of 8x9-in. white-oak beams, braced with 4x8-in. timber. The hopper is boxed with 2x12-in. oak timber. Waste rock is culled by hand and discarded, but as the sheet ore is uniform, comparatively little waste is encountered.

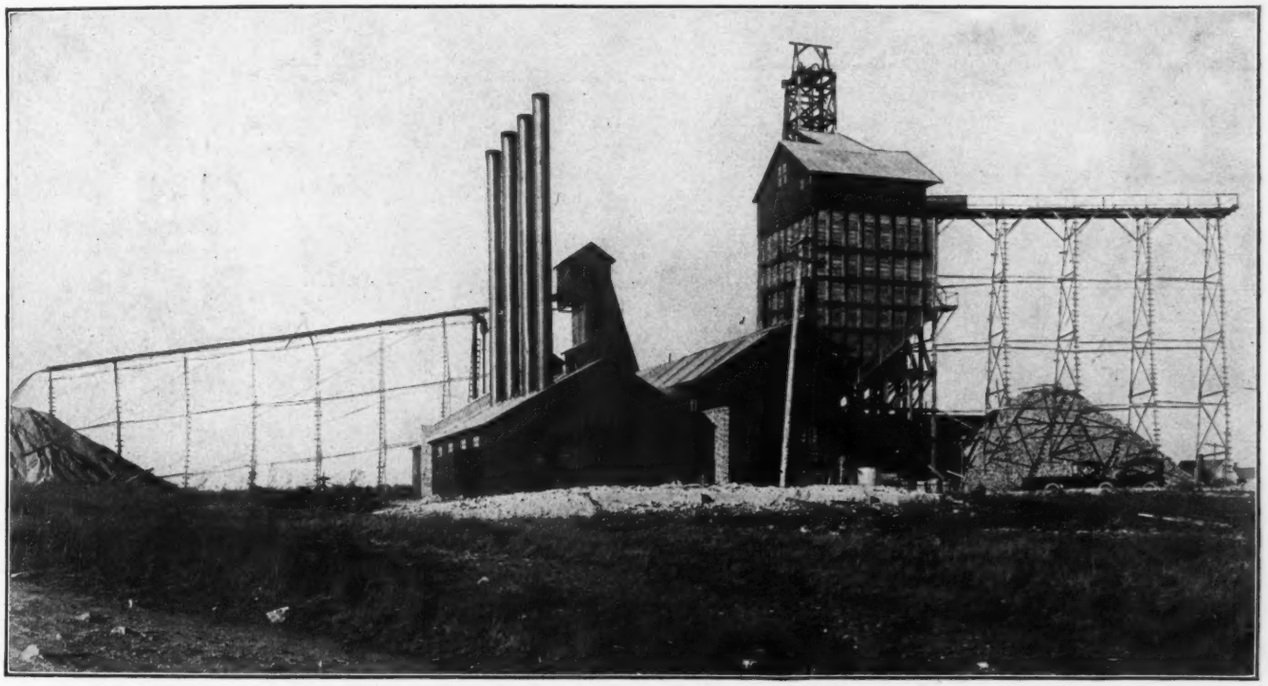
Ore is broken by two 18-in. Webb City-Carterville Foundry Co.'s crushers, after which it passes to two 48-in. trommels 96 in. long. Oversize from the ½-in. mesh goes to three sets of 42-in. rolls, the undersize passing to the rougher jigs. The feed to the rolls is interchangeable.

Each rougher jig has 6 cells, 42x48 in., and dewatering screens are used at the foot of each. The sludge-bearing water passes into large concrete settling tanks, while the tailings are elevated to the tailings flume and discarded. The cleaner jig has 7 cells, 36x48 in. One small sand jig has 3 cells, 30x42 in.

Steam power is used to run the mill machinery, the equipment consisting of four 150-hp. high-pressure boilers and a 16x42-in. Hamilton corliss engine. A 10x10-in. Chuse steam engine runs the sludge department which is in a separate building at the northeast corner of the main mill and is equipped with 11 tables, two of which are for slimes. Concentrates for the bin are recovered from each table.

One two-stage Corliss air compressor of 2,000-ft. capacity runs the drills. A barometric condenser pump is used. A Chuse engine, directly connected with a Triumph 110-v. dynamo supplies electricity for lighting the mill and drifts, and to the Electric mine, ¼ mi. distant, which is under the same management.

The ground is drained with a Dean triplex pump operated by a Chuse engine. It will pump 750 gal. per min. This pump is installed in the mill shaft. At an old shaft 300 ft. south, a Gwatney 3-stage centrifugal pump, with 500-gal. capacity, is used. A motor of 100 hp. capacity runs this pump.

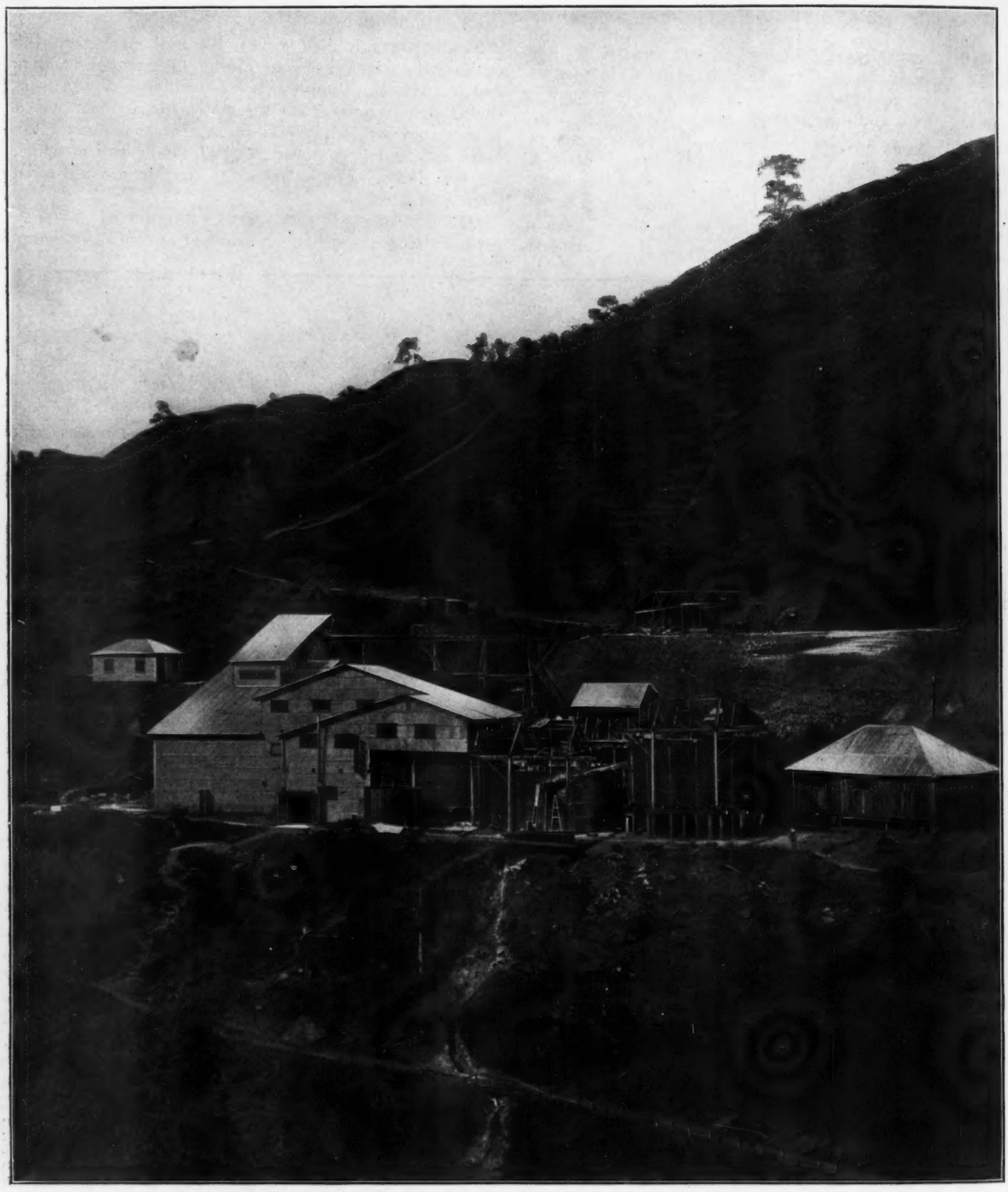


A VIEW OF THE MEDIA MILL, WEBB CITY, MO.

*Joplin, Mo.

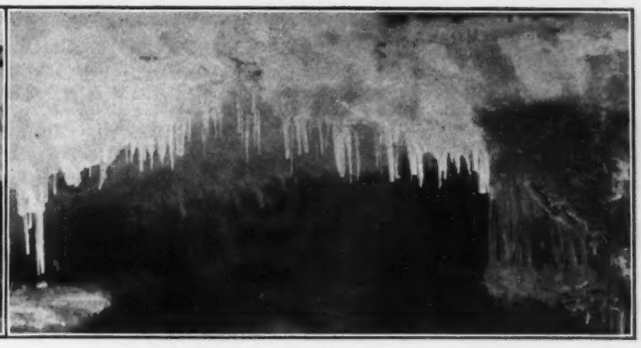
Braden Concentrates, of which about 350 tons are produced daily, have the following average composition: Cu, 19%; SiO_2, 17%; Fe, 23%; CaO, 2%; Al_2O_3, 8%; S, 28%. Of the 350-ton daily production, 50 tons are sintered, about 30 tons used in the acid plant when that is running, 85 tons are smelted raw, and the remainder nodulized in kilns. According to "Teniente Topics," the sulphur in the sinter is reduced from 28% to 12%, while the nodules contain about 18% of sulphur.

Photographs from the Field

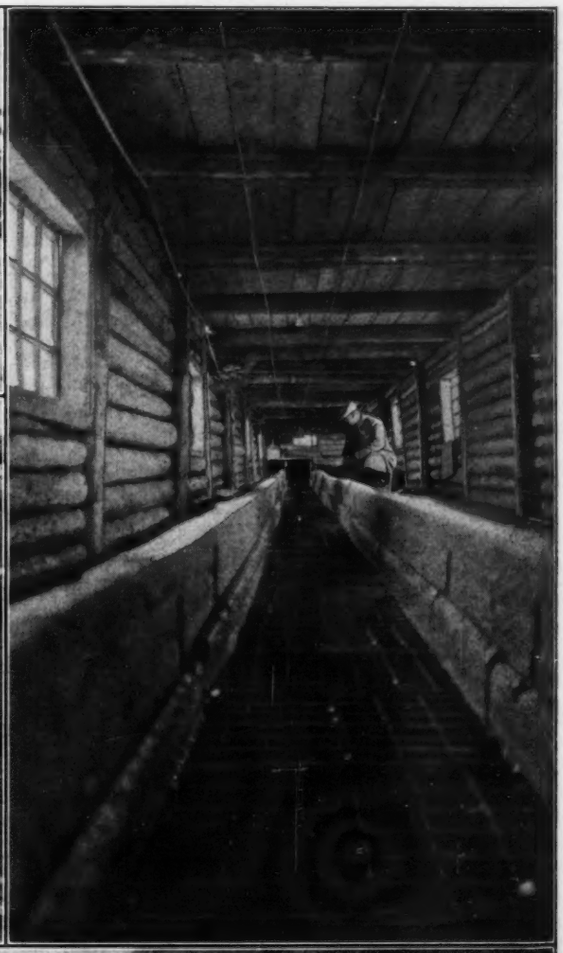


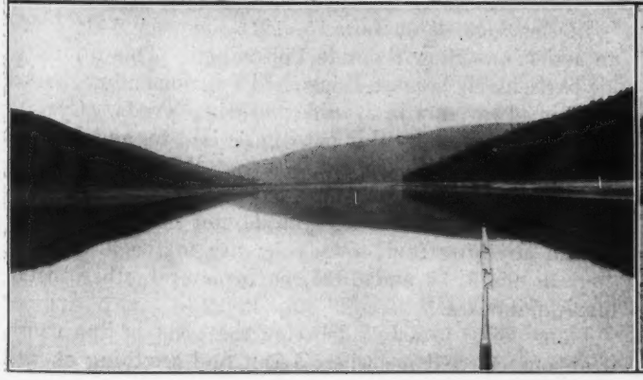
TEN-STAMP ALL SLIMING CYANIDE PLANT OF THE BENGUET CONSOLIDATED MINING CO., ANTAMOK, BENGUET PROVINCE, PHILIPPINE ISLANDS

ICE STALACITE FROM LEAKS IN A SMALL PIPE



NATURAL ICE ROOF OF BODAIBO RIVER, SIBERIA





WINTER MINING AT THE LENSKOI PROPERTY, SIBERIA

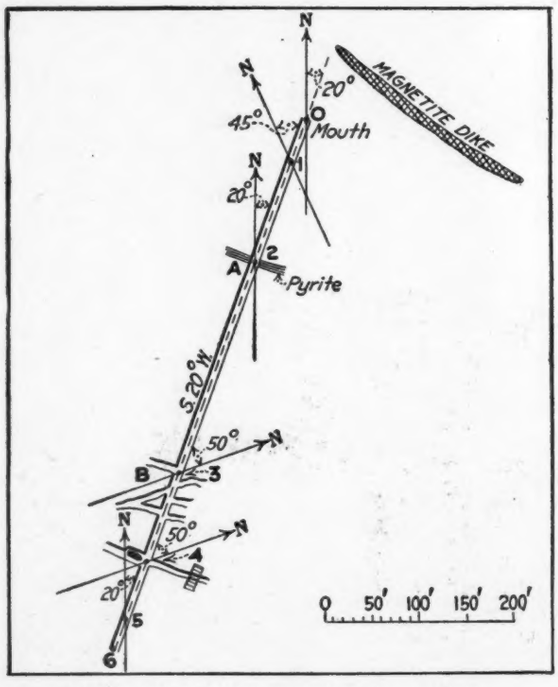
A view of the winter sluicing plant at the Lenskoi, and under it, calking the by-wash flume that carries water across the area being drifted. Also a view of the interior of the winter sluice. Two views of the Lena River are shown at the bottom

Correspondence and Discussion

Peculiar Magnetic Phenomenon

Edwin E. Chase's article in the *Journal* of Dec. 4, 1915, under the title "Peculiar Magnetic Phenomenon," gives a striking example of the unreliability of the compass in making underground surveys. His experience in the Caribou tunnel recalls some of my own experiences with a Brunton in which the needle readings gave little or no idea of the actual direction of mine passageways.

A possible solution of his problem is this: From Mr. Chase's description the rock is granite and schist; therefore we may expect to find other magnetite dikes or



THE CARIBOU MAGNETIC MYSTERY

concentrations, and possibly the vein *A* may continue on the east side of the tunnel. The mouth of the tunnel in his sketch is about midway between the known magnetite dike and *A;* thus each might tend to annul the effect of the other, with the result that the needle might read nearly correctly. As one goes farther into the tunnel, the effect of the magnetite dike decreases, while the effect of *A* increases until the vein *A* is crossed. From then on the needle would be deflected in the opposite direction until a point farther in is reached, outside the range of attractions of the magnetic mass.

From *B* to the electric hoist it seems as though the electric current must be the cause of the trouble. Beyond the hoist and in the drifts, on the other hand, the needle is outside the influence of the current and consequently is not affected.

My experience with the Brunton has been that accurate surveys cannot be made in mines by merely depending on the reading of the needle or the fore sight at each point, because in a perfectly straight tunnel it is next to impossible to get two needle bearings taken at different points to check. This is due to the interference of rails, mine cars, steel of all kinds, electric wires and the presence of magnetic masses in the neighboring rock.

I find that the most satisfactory method of using a Brunton is to read both back and fore sight from each station and thus determine the angle turned (always to the right) from the back sight. This will eliminate any inaccuracy in magnetic bearing, and with care, accurate work can be accomplished. By this method I have made a number of difficult underground connections in a satisfactory manner.

I will illustrate the method by trying to apply it to the case of the Caribou tunnel. Assume station 0 at the mouth of the tunnel, station 1 at the point of apparent deflection, station 2 at *A* the crossing of the pyrite vein, station 3 at *B,* station 4 near the hoist, station 5 about 50 ft. from the face of the tunnel and station 6 at the face. The notes would be about as given in the table.

NOTE OF SURVEY MADE WITH A BRUNTON

Stations	Back Sight Needle	Fore Sight Needle	Angle Turned to Right
0—1		S 20 W	
1—0	N 45 E		
1—2		S 45 W	180
2—1	N 20 E		
2—3		S 20 W	180
3—2	N 50 W		
3—4		S 50 E	180
4—3	N 50 W		
4—5		S 50 E	180
5—4	N 20 E		
5—6		S 20 W	180

Plotting the notes by angles turned from the back sight, as indicated on the rough sketch, it can be seen that the needle has no effect and merely acts as a stationary pointer about which the compass box turns, just as the outside circle of a transit moves about the fixed center, giving the angle turned regardless of the needle variation. This may explain why we say Brunton pocket transit.

H. D. PALLISTER.

El Paso, Tex., Dec. 24, 1915.

Slow Cyanide Poisoning

In the *Journal* of Jan. 15, 1916, on page 141, I find an article on "Slow Cyanide Poisoning." This interested me particularly because I have had a curious ailment since spending two years in cyanide work in Nevada. Cyanide poisoning is the only thing it can be laid to, and I am of course anxious to learn all I can on that subject. The slow effect of the poison on a man's system is not mentioned in the textbooks on cyanide, nor have I been able to find anything further by reference to the files of the *Journal* for 1914 and 1915, or in several other metallurgical indexes.

I am going to ask, solely for the good of the cause, if anyone can tell me where I can find anything on this subject. The doctors I have seen seem to be unfamiliar with this trouble, but it is an important matter to all who work about solutions. In my case the trouble has

been altogether with the nervous system, a partial paralysis taking place that wears off in time but leaves me weak. Incidentally I may mention that my two years as solution and refinery man followed a course at a school of mines, and while I have heard of other similar cases, I have never been able to get in touch with any of the men.

Keokuk, Iowa, Feb. 2, 1916. JOHN R. JANES.

[Readers may accomplish some beneficial results if they will advise the *Journal* of any similar cases that may have come to their attention and any successful methods of treatment. If such cases are frequent, their causes should be investigated.—Editor.]

Fineness of Ore Crushing for Assaying

The discussions on the decomposition of $NaHCO_3$ have reached a point that amounts to waste paper. I am surprised at the arguments Doctor Dewey puts forth (*Eng. and Min. Journ.*, Jan. 22, 1916, p. 187). He is either trying to score a point by loose statements, or else his information is at fault.

It is difficult to get the connection between the dissociation of $NaHCO_3$ in aqueous solutions and its action in assay fusion unless it is to indicate that the salt readily breaks up. A high temperature is used in the Solvay-process furnace to give a rapid heating of the mass and compensate for heat absorbed and CO_2-H_2O pressure resulting from decomposition of $NaHCO_3$. This in no way indicates at what temperature $NaHCO_3$ decomposes. It would be just as reasonable to argue that the boiling point of water was more than 100° C. because the temperature of the furnace in a boiler plant may reach 1,000° C.

The extract from Watt's dictionary is a misrepresentation and probably refers to the statement: "Sesquicarbonate $Na_4H_2(CO_3)_3$-$3H_2O$ may be prepared by melting together 1 Na_2CO_3-$10H_2O$ and 2 $NaHCO_3$. Sodium carbonate with 10 molecules of water melts at 35.1° C. (Roscoe and Schorlemmer, Vol. II, 1907, p. 274), and the salts are dissolved in its water of crystallization." It would be just as sensible to state that the two salts can be dissolved in water without decomposition, and have as much bearing on the subject.

One of the accepted methods for standardization in acidimetry and alkalimetry is to heat $NaHCO_3$ to bare redness, converting it to Na_2CO_3. The directions are to avoid fusion. $NaHCO_3$ is not used without conversion, because it cannot be kept free from Na_2CO_3 under ordinary conditions. Surely the analytical chemists are not all wrong.

The described appearance of fusion with bicarbonate fits well, also that with normal carbonate, only slightly more pronounced with the former. I have admitted the possibility or, better, probability that some $NaHCO_3$ may exist in the solid core of unfused charge with certain mixtures when fusions are made in a hot furnace, but fail to see that that proves any advantage.

Doctor Dewey says that the point at issue is whether $NaHCO_3$ decomposes, etc. This is not the case. The argument is whether $NaHCO_3$ has any advantages over Na_2CO_3 in assaying. If Doctor Dewey is really anxious to settle this point, I suggest that he select 10 silver ores (I leave the selection to him, as he states some ores may give good results with Na_2CO_3) and favor me with a portion, with the understanding that we are both to assay the samples and submit results to the *Engineering and Mining Journal* as referee. If we still fail to agree, the samples are to be umpired by a third party mutually satisfactory. E. J. HALL.

New York City, Feb. 19, 1916.

Simplified Spelling in A. I. M. E.

Misther Editor—Such a foine cellibrayshun as the 112th meetin' av the Institoot I niver attinded since the toime the Elks av Wallace, Idyho, entertained the lodge from Missoula, Montany. Somethin' doin' all the toime; an' the only regret was not bein' able to be in three places to wanst, so as to hear the readin' av all thim scientific papers as well as talkin' to owld an' new frinds. But some av thim new frinds lives as far away as Joplin, Missouri; while we can read the papers anny owld toime.

Ye might not belave it, but comin' up from Sandy Hook on the last day I felt so foine that I almost danced a couple av toimes on the quarther-deck av Sicrety Daniels' yacht.

But what I wants to ask ye about is this here new kind av spellin' we're to have a vote on.

I feel under obligayshuns to me frind Tim Dillon for slippin' me into such a foine organizayshun as the Institoot, but I don't like Tim's new fad. He writes me like this:

> Der Bil: I wood lik tu hav u voat in favr uv the nu speling reform which the Institut is abowt to tak up.
>
> Whil ther ar meni old memberz hu ar opozd tu it, u shood be an advocat uv enithing so ezi tu lurn. Yurz trull,
>
> T. MONTMORENCY DILLON.

Begorry, I think Tim is still under the influence av the Smoker, or else he is thryin' to put wan over on me. I'll vote agin the amindmint, an' stick to the old-fashioned spellin' that annybody can read.

Brooklyn, Feb. 28, 1916. BILL MCGINTY.

Smoke Farming Gains Prestige

May I call the *Journal's* attention to the fact that smoke farming has ceased to be the avocation of the alfalfa raiser and jackrabbit chaser of the Western States and has been admitted into the category of diversions of the ultra-fashionable? The aristocratic noses along Riverside Drive have too long been offended by the odors from the Barrett Manufacturing Co., the Bulls Ferry Chemical Co., the Valvoline Oil Co., the Midland Linseed Oil Co. of New Jersey and the Corn Products Refining Co., and the Supreme Court of the United States, with all the advantages and disadvantages thereunto appertaining, ordered these companies on Feb. 28 to show cause at the November term why they should not be enjoined from continuing the alleged nuisance.

In the meanwhile a flank attack has been started from Staten Island on the fertilizer factories and metallurgical establishments along Arthur Kill and Kill van Kull.

By the way, some of the inhabitants of Riverside Drive are themselves high in the councils of some of the Western stink-factories. I hope that that honor said to exist in certain strata of society has prevented their moving against their New Jersey neighbors. A. A. NASON.

New York, Feb. 29, 1916.

Imports and Exports of Metals in 1915

The Department of Commerce has now completed and issued the returns for the month of December and the calendar year 1915. The figures for the principal metals excepting iron and steel are given here.

Copper

Exports and imports of copper for December and the year were as follows, in pounds:

Exports:	December	Year
Copper contents of ore and matte	247,720	2,939,698
Pigs, ingots, bars, etc	85,753,902	681,953,301
Reëxports of foreign material	.....	801,872
Total	86,001,622	685,694,871
Imports:		
Copper contents of ore and matte	9,923,008	114,331,441
Copper, metallic	17,156,189	201,367,008
Total	27,079,197	315,698,449
Excess of exports	58,922,425	369,992,422

In addition to the quantities given, manufactures of copper were exported valued at $1,005,043 in December and $7,885,434 for the year.

Tin

Imports and exports of tin for December and the year 1915 are reported as follows, in pounds:

	December	Year
Imports	11,023,229	115,636,332
Reëxports of foreign material	47,581	1,239,144
Net imports	10,975,648	114,397,188

Exports of manufactures of tin not including tin-plate—which is included with iron and steel—were valued at $176,627 for December and $2,444,611 for the year.

Lead

Imports and exports of lead in the United States in December and the year ended Dec. 31 are reported as follows, in pounds:

Imports:	December	Year
Lead in ore	1,152,686	18,185,140
Lead in base bullion	14,311	83,986,988
Lead, pigs, bars, etc	41,845	819,282
Total lead	1,208,842	102,991,410
Exports:		
Lead, domestic	17,155,303	174,184,177
Lead, foreign, reëxported	10,917,350	76,902,512
Total lead	28,072,653	251,086,689

Imports were chiefly from Mexico, which furnished 93,558,927 lb. Other imports were from Canada, Chile, Salvador and Australia, the last-named country sending 5,000 tons in December. The foreign lead reëxported was smelted or refined here from imported ores and bullion.

Zinc

Imports and exports of zinc in the United States for December and the year are reported as follows, in pounds:

Imports:	December	Year
Ore, zinc contents	29,158,777	111,337,046
Metallic zinc	147,690	1,808,964
Total zinc	29,306,467	113,146,010
Zinc dust	298,115	1,712,373
Exports:		
Zinc, metallic	20,928,349	261,814,958
Zinc dross	.....	8,333,515
Zinc dust, reëxports	60,137	431,815

Of the ore imported in December, 26,261 tons came from Australia, 5,485 tons from Mexico and small quantities from Canada, Japan, Guatemala and Peru; making a total of 33,016 tons. The zinc dust reported in December was received from Japan, England, Germany and France.

Military Engineering Lectures

At the first of the series of lectures on military science given in the auditoriums of the United Engineering Societies' Building, 29 West 39th St., New York City, Feb. 14, the topic was the work of the engineer troops in general and the work of the bridge building details in particular. A large number of slides were thrown on the screen which showed the ground over which reconnaissance was made, the building of bridges by the pioneer and the pontonier battalions, the bridges being crossed by cavalry, infantry, and combat trains, and the completed blockhouses with their cover and screen, and the necessary trenches, entanglements and *chevaux de frise* for their protection.

Some of the pertinent statements made and figures given by Capt. T. M. Robins, of the Engineer Corps, are:

Success or failure in war depends more than ever upon the engineering skill and resources of a nation. Engineers realize this, and this realization is the biggest asset for defense that the country has today.

For every 60,000 infantrymen in the United States Army five battalions of engineers are intended, but this provision is only half the German proportion of six engineers for every 100 infantrymen.

The United States at present has in the regular service about 248 engineer officers and about 19,000 men enlisted in the Engineer Corps. In addition there are only about 60 officers in the Militia Engineering Corps and about 1,500 men. Assuming that we would need 500,000 troops for our first line of defense, our engineering needs would be 1,200 engineering officers and 36,000 engineering enlisted men, 8,000 of whom must be noncommissioned officers of high engineering ability. This is only one-fourth the total men needed to supplement, and maybe supplant the first line army.

The question asked by the engineer is: "How can I get military training to prepare myself for war?" This can come only by applying your technical knowledge at the summer camps, such as that at Plattsburg, or through enlistment in the militia. You should read all the books[1] on military engineering that you can, but reading alone will not give you military training.

The speaker never once implied a doubt of the certainty of a war between this country and a first-class power, and every time he mentioned the United States at war, he used the simple future tense.

The talk was a most impressive one from the fact that Captain Robins pointed out wherein all of the engineers with their specific lines of endeavor would be utilized in time of war. And he pointed out where not only the technical abilities of the men would be used, but he showed where the men who were so qualified, but whose age or whose physique would not permit them to engage in the rough campaign at the front, could be utilized in the all-important work on the line of communications or in the service of the interior. The entire audience of 1,300, which packed the main auditorium so there was not even standing room, was held to the strictest attention by the talk, which brought home more than ever before to the engineers their obligations as to preparedness.

The second of the series of lectures was delivered by Capt. R. T. Coiner, of the Engineer Corps of the United States Army, Feb. 21. Although the attendance did not equal that of the first lecture, from which many were turned away, the auditorium, both main floor and gallery, was filled with as many as could be comfortably accommodated. The lecture was on the subject of reconnaissance, including surveying, mapping, photography and map reproduction. The third lecture on Feb. 28 will be printed in the *Journal* Mar. 11.

[1]See long list of books in "Military Reading for Civilian Engineers," "Eng. and Min. Journ.," Feb. 5, 1916, p. 257.

Editorials

Why Great Britain Does Not Increase Zinc Smelting

Our esteemed contemporary, the *Mining Journal*, of London, has commented upon certain remarks that we made recently with respect to the sluggishness of the British in developing their zinc-smelting industry, especially since the outbreak of the war, when the shortage of spelter became a national emergency. The *Mining Journal* says: "But we think our contemporary will be the first to acknowledge that if the United States Government had said to its smelters, as the British government has said to all enterprises in this country, 'We will not allow you to appeal to the public for capital, and if you raise capital privately you will have to be satisfied with 6% return on your money until such time as we decide to take off the excess-profit tax,' that the reply from the United States would have been equally 'Nothing doing.' We have been informed specifically that the government action put an end to important schemes which otherwise had obtained influential support."

We bow to this decisive revelation by our British contemporary. Not even in ordinary times would anybody in full possession of his senses in the United States supply capital for an industrial enterprise to yield only 6%, unless such yield were guaranteed by the Government. The preferred stocks of our best, most thoroughly seasoned industrial companies sell on a better basis than 6%. In providing capital for new zinc smelteries in this country in 1915, adventurers were not very much attracted until they saw a reasonable prospect of getting all their capital back within a year.

Our British contemporary admits generously that a cause for apprehension with regard to the development of British zinc smelting is the recognition of the inefficiency or slackness of British labor. We fear, however, that our friends in Great Britain are building castles in the air if they think that they "are offered in the success of the electrolytic process a virtual solution of this difficulty."

Profit-Sharing in Lead and Copper Mining

The lead producers of the Coeur d'Alenes have imitated the practice of the copper producers generally by introducing a new wage scale making the rate of wages advance according to the price for lead. This is a very simple and satisfactory method of profit sharing. It was instituted by the Anaconda Copper Mining Co. at Anaconda. Having proved so practicable there, the adoption of the system, modified to meet local conditions, spread among the other copper-mining districts, so that now it prevails in nearly all of them, the Lake Superior region being the most important exception.

It is but natural that the same system should be extended to the great lead-mining districts. With this system of a guaranteed minimum and a generous participation in the profits when times are good, the producers of lead and copper appear to have discovered an effective way of doing the fair thing by their men and consequently keeping them contented. This should go a long way toward eliminating labor troubles.

London Standard Copper

The great disparity between the prices for electrolytic and for standard copper in the London market, that has been in evidence ever since the war began, continues to exist. Last summer, when the British government released standard copper for export under prescribed conditions, it was thought that there would be a gradual return to normal conditions, especially for the reason that American refiners would be able to enter the London market and buy crude copper there for refining here. However, American refiners have not gone into the British market to any considerable extent, for the reasons that the difficulties in getting copper out of England are too vexatious and, moreover, there has been an ample supply of crude copper from other quarters.

The London standard market has, therefore, resolved itself into a severely circumscribed speculative market in crude copper, and the price for that kind of copper may go up or down without any relation to the price for electrolytic, which reflects the great commodity market. The utter insignificance of the quotations for London standard copper is gradually becoming recognized in this country, with the result that less and less attention is being paid to the London cables.

Another Attack Is Made Upon International Nickel

About a year ago the International Nickel Co. became the target of some of the cheap politicians in Canada, allegations that it was supplying Canada's nickel to Canada's enemies being freely and carelessly made. These were fully refuted by the statement of Mr. Monell, the president of the company, that its business was practically being conducted under the supervision of the Canadian government, and no one had to read very closely between the lines to determine that such supervision was welcomed by the company.

The stupid and malicious charges against this company having been allayed, there continued in Canada an agitation—perfectly natural and even praiseworthy—for the refining of some of Canada's nickel within the confines of the Dominion. That this had not been done previously was due without doubt to the ability of the International Nickel Co. to perform the refining process more economically elsewhere. However, it was not irrational of the Canadians to ask that at least some of so essential a metal should be produced at home and under their absolute control. The administration of the International Nickel Co. recognized this and lately agreed to erect a new refinery in Canada.

After such an exhibition of propriety and generosity by this company, it is surprising to read of another asinine outbreak in the House of Parliament, and a reiteration of the old charges that "the Huns are being supplied with Canadian nickel" while the British government is being stuck in the price for it. As a matter of fact, nickel is the *one* important metal that has not advanced largely in price during the war. In July, 1914, nickel was quoted by the *Journal* at 40@45c., and that quotation prevailed until August, 1915, when the price was raised to 45@50c. We have heard it said that the British government is being supplied with nickel under contract at a price less than what prevailed before the war. We do not know what truth there is in that, but it is certain that in the open market the price for nickel has been raised only a beggarly 10%, while the price for spelter has advanced 400 to 500%, and even more startling things have happened in antimony, quicksilver and tungsten. The moderation of the nickel monopoly is amazing.

Unworked Mineral Lands

The holding of large tracts of mineral lands without working them has been one of the characteristics of the later mining industry in Central and South America. This condition exists to a certain extent in the United States, but is not so marked as it now is in the republics to the south.

In many of the Latin-American republics the mining industry is backward because the owners of mineral lands are waiting for foreigners to come and buy their properties, which they have no intention—and often no means—of exploiting. The laws and political conditions in some of these countries cause the foreign capitalist to hesitate about investing; he is concerned about the security of his investment and would much rather put his money in an enterprise at home than in one in a foreign country where he has no influence and where revolutions or new political administrations may change or cancel the guarantees originally given when his investment was made. Meanwhile the native owners hold the property—not possessing the means of exploitation and often having no capacity or training in this direction.

Except as developed by foreign capital, the mining industry in most of the South American countries has declined from its original activity when the rich deposits were first opened. This condition is in great measure due to the lack of application of capital and technical skill to the lower grade deposits that undoubtedly exist in these countries. The exploitation of such areas, however, requires the introduction of greater capital than is usually at the command of one man, and in the absence of favorable political conditions the capital necessary to develop and operate the low-grade deposits has not been available.

In several instances higher taxes have been imposed as soon as production on an important scale was initiated. The clapping on of higher export duties is not calculated to stimulate further development of these low-grade deposits. The prosperity of the country would be placed on a sounder basis by the establishment of more industries providing steady employment for the people than by heavy taxation of the one or two established operations. Untaxed development of its mineral lands has put the United States in the forefront of mining countries; its mineral industry employs many more people today and is vastly more important than in the earlier bonanza days when only the rich deposits were being operated. An equal opportunity exists in many of our Southern republics similarly blest with latent mineral resources.

The attitude of the native owner in holding his mineral lands unworked and waiting for the foreigner to come in and open up the properties has resulted in a decadent mining industry in Latin-American republics that were once the most active mining centers of the New World.

Honduras in colonial times employed a large percentage of its people in the mining industry. Much of the mineral land of the country is now held in grants or zones by the payment of small annual rental fees, and in consequence little active work is being done; the owners are awaiting the arrival of foreigners who will buy and operate the properties. The country, however, is growing weary of the inactivity, and a bill is now before the Honduran congress to abolish the annual rental tax and restore the older colonial system, which required mineral lands to be worked. Under this system Honduras had a large part of its population engaged in the mines. The work-the-claim method would doubtless create a new mining activity. Will the Hondurans have the faith to see the thing through?

Atmospheric Nitrogen

In a discussion of a paper on the Chilean nitrate industry, offered at a meeting of the mining and metallurgical section of the Pan-American Scientific Congress, at Washington in December last, a forceful speaker, Dr. Allerton Cushman, director of the Institute of Industrial Research, made the point that the United States ought to make itself independent of Chilean nitrate. He drew attention to the essential character of raw material for making nitric acid for the explosive industry and to the danger that the United States might be deprived of such supply if its sole reliance were on Chile. In this connection Doctor Cushman made the startling and dramatic statement that when a European war was threatened a few years ago, it was the common belief that hostile action by Germany was restrained by her bankers; in fact the restraint was exercised by her chemists. The German bankers, it is alleged, entered no demurrer at that time, but the chemists did. They said that they were not ready then, but that within a few years they would be. Since then the world has seen how wonderfully they fulfilled their promise.

The first practical steps toward getting nitrogen out of the atmosphere were made by Charles S. Bradley at Niagara Falls, but American capitalists were too indifferent, or timid, or short-sighted to develop his process. However, nitric acid from the atmosphere is now being made on a small scale in Nevada, while James B. Duke, of the Southern Electro Chemical Co., which has a plant at Great Falls, S. C., about 50 miles from Charlotte, N. C., announced recently that his company was about to begin the production of four tons of nitric acid daily, employing the Pauling process.

The high cost of power in this country, even $18 to $19 per hp. year at Niagara Falls, compared to $6 to $7 in Norway where nitrogen fixation has reached its greatest importance, has militated against the extension of the process here. A power cost lower than that at Niagara Falls is anticipated in this new southern plant.

BY THE WAY

An echo from the past was heard in the auction sales on Feb. 23 in New York, when 500 shares Kuenzel's Process Smelter Co., $1 par, and 200 shares Central Fdry., pfd., old stock, sold at $5 for the lot.

⁂

We take it to be beyond dispute, says the New York *Sun,* that nobody ought to learn to swim. Man being a terrestrial animal, it is impossible that he should ever find himself in water beyond his depth. Time and money spent in learning the art of swimming are therefore sheer waste—just as much so as if spent in military training. Obviously there is no more chance of a man's being drowned than there is of his having to fight for his country.

⁂

Persons representing the Ambraw Milling Co., which is claimed to own a gold deposit at Dollsville, near Gloversville, in the Adirondacks, New York, are selling stock among the farmers in Illinois. This having been brought to the attention of D. H. Newlands, assistant state geologist of New York, he promptly communicated information to the scene of the stock-selling operations, explaining the facts regarding the alleged occurrence of gold in the Adirondacks. The New York authorities and the *Journal* have repeatedly exposed Adirondack gold swindling schemes, but they constantly bob up again.

⁂

After the Committee on Mines and Mining had held hearings during nine days and had heard evidence and arguments to the extent of 175 printed pages, the following colloquy occurred in the form of an interruption of Mr. Taylor, of Colorado, who was making the concluding argument. "If you will not grant us this request," said Mr. Taylor, "we feel you are simply turning against the mining interests of the West without any justification whatever."

Mr. Garland: "Does the Bureau of Mines advise for this?"
Mr. Taylor: "Oh, yes."
Mr. Garland: "I did not understand that the Bureau of Mines had advised for it."

Hon. Van. H. Manning, Director of the Bureau of Mines, had appeared before the committee, making a strong argument in favor of the proposed revision, but up to the ninth day Mr. Garland, of Pennsylvania, had failed to gather that the Bureau of Mines was in favor of it. On the ninth day also, Meyer London, the socialist member, was still inquiring what recognition of organized labor there was going to be in a revision of the mineral-land laws. These incidents illustrate the character of the committee that by a majority of one vote denied the mining industry of the West the reform that it wants and knows to be necessary.

⁂

A big copper company's first-aid team that won two prizes at a state fair was engaged in a final practice on the evening before departing for the fair. Somebody rushed into the hall and announced that a man had been stabbed and was lying at the corner of the building. The first-aiders ran out and brought in the victim. He was totally unconscious and, as it developed later, had 10 knife wounds in his body. The boys stretched the poor fellow on the canvas and began their work of resuscitation. "Doc," captain of the team, professionally took his position at the patient's head, lighted a cigarette and blew a cloud of smoke in the patient's face. George, being composed and remembering the instructions literally, seized the patient's hand and began to rub the arm vigorously toward the heart, thrusting his finger into a large slash in the ulnar artery at the first stroke. Having thus ascertained the nature and extent of the injury, he promptly applied a tourniquet between the wound and the wrist. Meantime others were not idle: Charley securely swathed the patient with roller bandages between shirt and coat from shoulders to hips, Frank tied a string around the patient's thigh (there were no wounds on the lower limbs), and Jack tightly bound the patient's neck. Last but not least, Bill raised the head, poured down a glassful of diluted spirits of ammonia and the patient breathed no more.

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February Mining Dividends

Dividends paid in February, 1916, by 24 United States mining companies making public reports amount to $7,801,400, as compared with $2,182,338 paid by 20 companies in February, 1915. Metallurgical and holding companies allied to mining paid $8,312,417, as compared with $8,175,267 in 1915. Canadian and Mexican mining companies paid $2,190,262 in 1916, as against $689,474 in 1915.

United States Mining Companies	Situation	Per Share	Total
Alaska Treadwell, g	Alaska	$0.75	$150,000
Alaska United, g	Alaska	.30	54,060
Anaconda, c	Mont.	1.50	3,496,875
Bunker Hill Con., g	Calif.	.02½	5,000
Bunker Hill & Sullivan, l.s.	Ida.	.25	81,750
Caledonia, l.s.	Ida.	.03	78,150
Champion, c	Mich.	2.00	200,000
Colo. Gold Dredging, g	Colo.	1.00*	100,000*
Golden Cycle, g	Colo.	.02	30,000
Hecla, l.s.	Ida.	.10	100,000
Homestake, g	S. D.	.65	163,254
Horn Silver, l.s.z	Utah	.05	20,000
Hercules, l.s.	Ida.	.20	200,000
Jim Butler-Tonopah, g.s.	Nev.	.10	200,000
May Day, g.s.l.	Utah	.03	24,000
Miami, c	Ariz.	1.25	466,946
Mohawk, c	Mich.	7.00	700,000
National Zinc and Lead, z.l.	Mo.	.04	20,000
New Jersey Zinc, z	N. J.	4.00	1,400,000
Success, z	Ida.	.03	45,000
Socorro, g	N. M.	.05	18,865
Wasp No. 2, g	S. D.	.02½	12,500
United Verde, c	Ariz.	.75	225,000
Wilbert, l.s.	Utah	.01	10,000
Yellow Pine, l.g.s.	Nev.	.10	100,000
Metallurgical and Holding Companies	**Situation**	**Per Share**	**Total**
Cambria	Penn.	$1.12½	$1,012,500
Greene-Cananea, c	Mex.	1.00	486,209
Gulf States Steel, 1st. pfd	Ala.	15.16	191,100
International Nickel, pfd	N. J.-Ont.	1.50	133,689
St. Mary's Min. Land, c	Mich.	1.00	160,000
Venture Syn	U. S.	.10	4,000
White Knob C. & D., pfd	U. S.	.10	20,000
U S. Steel, pfd	U. S.	.01¾	6,304,919
Canadian and Mexican Companies	**Situation**	**Per Share**	**Total**
Amparo, g.s	Mex.	$0.06	$120,000
Arizona, c	Ariz.	.24	369,335
Coniagas, s	Ont.	.25	200,000
Dominion Steel, pfd	N. S.	1.50	155,000
Hollinger, g	Ont.	.20	120,000
Seneca Superior	Ont.	.20	95,777
Standard, s.l.	B. C.	.02½	50,000
Mond Nickel, 1st pfd	Ont.	.34	170,100
Mond Nickel, 2nd pfd	Ont.	.34	340,200
Mond Nickel, com	Ont.	.24	228,700
Stand. Steel of Canada, pfd	N. S.	.01¾	113,750
Stand. Steel of Canada, pfd.†	N. S.	.03½	227,500

* Return of capital. † Account back dividends.

The dividend paid by Horn Silver is the first since September, 1907. The dividend paid by the Colorado Gold Dredging was a return of capital.

Total dividends in the first two months of the year paid by United States mining companies amount to $14,659,676; by metallurgical and holding companies, $12,544,296; by Canadian, Mexican and Central American companies, $3,922,519.

PERSONALS

Alva C. Dinkey has been elected president of the Cambria Steel Co.

John W. Finch has recovered from his serious illness in New York.

Charles A. Burdick, of New York, is in the Blue Ridge region of Virginia examining manganese properties.

Ott F. Heizer, of Idaho Springs, Colo., will be in Tuolumne, Calif., for the next two months on professional business.

E. T. Stotesbury has been chosen Chairman of the board of the Reading Iron Co., Reading, Penn. F. C. Smink is president of the company.

Adolph Lewisohn, of New York, has given $5,000 a year for three years to be used in the operations of the Bureau of Philanthropic Research.

Willis P. Davis, of Louisville, Ky., has been chosen general manager of the Knoxville Iron Co., Knoxville, Tenn., in place of T. L. Stephenson, deceased.

George F. McKay, who has been secretary and treasurer of the Otto Coking Co., 6 Church St., New York, since its organization two years ago, has resigned.

William Pigott, vice-president of the Pacific Coast Steel Co., who has been in the East for some time, purchasing rolling-mill machinery, has returned to Seattle.

P. Kirkegaard is reopening the gold mines at Cordova, Ont., and is preparing to purchase machinery for that purpose, including electrical motors and air compressors.

Eugene G. Grace is now president of the Bethlehem Steel Corporation, Charles M. Schwab remaining chairman of the board. H. E. Lewis has been appointed assistant to the president.

W. J. Lavelle, New England Coal and Coke Co., Boston, Mass., has been elected secretary-treasurer of the By-Products Coke Producers of America, a new organization recently formed in Chicago.

Edwin Higgins, chief mine inspector, and deputy G. Chester Brown, of the California Industrial Accident Commission, are on a visit of inspection to the Mother Lode mines, where large improvements are being undertaken.

W. W. Mein sailed from New York, Feb. 28, for England, on his way to South Africa, to investigate some of the Rand mines. He is taking as assistants Karl F. Hoffmann, of New York, and Fred Searls, Jr., of San Francisco, California.

Charles T. Kirk, of the University of New Mexico, has recently returned to Albuquerque from a trip to the tungsten fields of Boulder County, Colorado, where he reported upon a concentrating property in the southern portion of the Nederland district.

Frank Davis has returned to Sal-si-puedes, in Southern Sonora, to resume mining operations. Because the railroad was cut south of Nogales by Villistas it was necessary to go via San Francisco and Mazatlan, traveling 2,760 mi. to accomplish a distance of 360 mi.

Dr. F. W. Cunningham, of Orange, N. J., has resigned his connection with the research and development work of the Newark plant of the General Electric Co. to join the engineering-research staff of the Powdered Coal Engineering and Equipment Co., of Chicago, at which point he is now located.

Joseph H. White, sanitary engineer of the U. S. Bureau of Mines, is investigating the conditions of the mines in Amador County, California, in relation to the reported prevalence of hookworm. The State Department of Health and the Industrial Accident Commission are coöperating with the Bureau to locate, diagnose and eradicate the hookworm.

William C. Russell has been appointed general manager of the Caribou Mines and Mills Co., a corporation made up of Chicago capitalists who have just taken over the interests of the Cariman Mining and Milling Co., operating the Caribou and the Boulder County properties in Boulder County, Colo. Extensive operations are planned. The Caribou mine was a famous silver producer in the '80's, but has not been operated for 27 years.

Dr. Henry K. Benson, professor of industrial chemistry at the University of Washington, in Seattle, has been appointed director of the newly established Bureau of Industrial Research, the first such institution on the Pacific Coast. One fellowship dealing with a problem of the iron and steel industry and amounting to $2,000 has already been established as a result of the coöperative spirit existing between the Bureau and the business men of the Pacific Northwest. Other fellowships are contemplated.

OBITUARY

George R. Ray, president of the Manistee Iron Works Co., at Manistee, Mich., died Jan. 3. Mr. Ray was a pioneer and prominently identified in the development of equipment, particularly the vacuum pan, for the manufacture of salt.

Franklin Guiterman, metallurgist and smelting expert for the American Smelting and Refining Co., left a net estate of $363,684 when he died on May 9, 1915. Mrs. Mary B. Guiterman, the widow, received $121,028, while Kenneth S. Guiterman, the son, received the balance.

William A. Dinker died in Pittsburgh, Feb. 20, aged 66 years. He organized and was secretary of the Eureka Coal Co., later absorbed by the Pittsburgh Coal Co., of which he became purchasing agent. Mr. Dinker also was secretary of the Great Lakes Coal Co., and had been identified with the coal interests of Pennsylvania for many years.

Joseph L. Darrah died at Los Angeles, Calif., Feb. 6, at the age of 88 years. Mr. Darrah was born in Ohio. He went to California in the boom days of the Cerro Gordo mines, in Inyo County, about 1870. He was one of the owners of the smelteries at Swansea, near Owens Lake, which treated the ores from the Cerro Gordo and other mines in the district. For a long time he was the active head of the smelting enterprise. He afterward retired from active mining and devoted his time to improving ranch property and accumulating a competence for his later years. The family home for several years has been at Pomona.

W. P. Carpender died at Placerville, Calif., Feb. 16, at the age of 85 years. He was born in Bristol, Vt., in 1831. He went to California in 1852, making the trip around the Horn in a windjammer. He went directly to Hangtown, now Placerville, where he was engaged in mining for 31 years. He then moved to Smith's Flat and was there for about 30 years, but in the last few years of his life, he spent much time at his office in Placerville. He was owner of a large amount of mining property, including the Carpender-Kumfa mine. This mine became noted as a producer, but for some legal entanglements, Mr. Carpender did not secure all of the benefits that should have been his. He was a man of extraordinary intellectual attainments and peculiarly rigid in his demands for justice, to others as well as to himself. His wife died several years ago and he is survived only by his son, Bert Carpender.

Dr. Francis Wyatt died Feb. 27 at his home at Forest Hills, Long Island, aged 61 years. He was born at Portsmouth, England, and educated in that country. He came to the United States about 1885 and settled in New York, where he soon became known as an expert chemist. At one time he was a frequent contributor to the "Journal," but later he turned his attention to organic chemistry and especially to fermentation, on which he became a high authority. He was chemist and for 10 years past president of the National Brewers' Association. He was a member of the American Chemical Society, the Society of Chemical Industry, the Association for the Advancement of Science, the British Institute of Brewers and Brewing, the University Club of Philadelphia, the Algonquin Club of Boston, and the Lambs Club of New York. Doctor Wyatt had recently retired from active life. He is survived by his wife.

Dioval Benedetto Spagnoli died at Jackson, Amador County, Calif., on Feb. 12, of pneumonia. He was born in Piedmont, Italy, in 1840. His early education was obtained at Palanza, Italy, and St. Etienne, France, and he graduated from Vevey College on Lake Geneva in 1854. He then came to America with his parents and brother by the Nicaragua route. The family went to California and to Amador County, where the father was engaged in mining and mercantile business. Although educated for the law, young Spagnoli became directly interested in mining and followed the Fraser River gold excitement in British Columbia and had some very exciting experiences of the dangers of Fraser River navigation. Returning to Amador County, he became county clerk in 1866, then auditor and recorder, later assistant district attorney. He was for seven years associated with Curtis H. Lindley, the authority on mine law. In 1869 he married Rosa Isabella Bryant, who died in 1874. In 1882 he married Ida B. Kerr, daughter of the late Professor A. W. Kerr. Mrs. Spagnoli and four children survive. Mr. Spagnoli was one of the oldest members of the Masonic fraternity in Amador County. He had other fraternal relations. Politically he was a democrat and in 1895-7 was United States Consul at Milan, Italy, appointed by President Cleveland. It is believed Mr. Spagnoli was the first naturalized Italian to hold public office in California.

SOCIETIES

American Pig Iron Association—At the annual meeting in Cleveland, Ohio, Feb. 18, the following officers were elected: Joseph G. Butler, Jr., president; F. B. Richards, of M. A. Hanna & Co., Cleveland, treasurer, and John A. Penton, Cleveland, secretary.

University of Michigan—The university has issued a bulletin, outlining its course in chemical engineering. Special reference is made in the pamphlet to the graduate fellowships, one of which has been established by the Detroit Edison Co. This fellowship is open to graduates of any university.

American Electrochemical Society—This society will hold a joint meeting with the American Institute of Electrical Engineers on Mar. 10 at the Engineering Societies Building, to discuss the subject of corrosion. The principal speakers will be: Dr. Burton McCollum, Bureau of Standards, Washington, D. C., for the American Institute of Electrical Engineers, and Prof. William H. Walker, Massachusetts Institute of Technology, Boston, Mass., for the American Electrochemical Society.

Northwest Mining Convention—The annual meeting will be held at Spokane, Wash., Mar. 20-25. L. K. Armstrong is chairman of the Committee of Arrangements.

An entire week, beginning Monday, Mar. 20, will be devoted to the Convention. The first two days are for the placing of ore exhibits in the Hotel Spokane. Mar. 22 to 25 have been set aside for a full discussion by mining men of live topics connected with the industry. These discussions concern not only those interested in the practical side of mining, but the technical men as well, for the members of the Columbia Section, American Institute of Mining Engineers; Spokane Section, American Society of Civil Engineers; Spokane Section, American Institute of Electrical Engineers, and of the Spokane Engineering and Technical Association will conduct special programs during the convention. Washington, Idaho, Montana, Oregon, British Columbia, Alberta, Alaska and Yukon Territory, all will be represented by delegates and ore displays. Delegates also will be present from California, Utah, Colorado and other Western states. Arrangements have been made to provide space for the display of ores, maps, mine models, literature, photographs and other exhibits of interest to mining people.

The Colorado Metal Mining Association held its annual convention at the Brown Palace Hotel, Denver, Feb. 11 and 12. About 250 delegates were present, representing the various mining counties of the state. The meeting was called to order at 10:30 a.m., Feb. 11, by President Bulkeley Wells, and was addressed by Governor George A. Carlson. W. J. H. Doran, president of the Denver Manufacturers' Association, addressed the convention on behalf of the manufacturing interests of Colorado. President Bulkeley Wells made his annual address, reviewing the accomplishments of the association during the past year and outlining the work to be done by the organization during 1916. A committee on resolutions was appointed and the convention adjourned until afternoon. Luncheon was served to members of the convention by the Denver Manufacturers' Association at the Chamber of Commerce Building. In the afternoon reports were submitted by the treasurer, secretary, finance committee, legislative committee and other committees.

The convention adjourned until evening and a meeting of the board of directors was called. The following officers were elected. Bulkeley Wells, president; T. R. Henahen, first vice-president; George M. Taylor, second vice-president; George O. Argall, third vice-president; M. B. Tomblin, secretary; A. M. Collins, treasurer.

The evening session of the convention opened with an address by Dr. Wm. B. Phillips, president of the Colorado School of Mines. Doctor Phillips pointed out what the School of Mines was doing for the mining industry, called attention to the new departments of safety and efficiency engineering and research, and showed how the latter department was aiding the prospector by making determinations and suggestions free of charge. Attention was called to the important cooperation between the School of Mines, the Federal Bureau of Mines and the Colorado State Bureau of Mines. Fred Carroll, commissioner of mines, then addressed the meeting and called attention to the State Bureau of Mines, pointing out its valuable services to the mining industry. W. W. Green, manager of the State Compensation Insurance Fund, addressed the convention and was followed by Thomas F. Daly, manager of the Capitol Insurance Co.

On Feb. 12, there was a long and sharp discussion on United States Conservation Policies.

INDUSTRIAL NEWS

The International Acheson Graphite Co., of Niagara Falls, N. Y., has changed its name and hereafter will be known as Acheson Graphite Company.

The Herrmann Engineering Co., 654 Franklin St., Detroit, Mich., has recently been reorganized, and will be known in the future as the Carson Motor Co.

The Traylor Engineering and Manufacturing Co., of Allentown, Penn., has recently supplied two Wood flotation machines for the Pike Hill mines, and 12 Wood flotation machines for the San Francisco Mines of Mexico.

The H. Koppers Co. has closed two contracts to erect by-product coke ovens with benzol recovery plants. One is of 45 ovens for the Camden Coke Co., Camden, N. J.; the other is for the Seaboard Byproduct Co., Jersey City, N. J., of 110 ovens.

At a recent directors' meeting of the Stanley Belting Corporation Charles E. Hathaway, formerly with the J. H. Williams Co., New York, was elected president; A. L. Whittemore, vice-president; A. C. List, treasurer; John Laurence was reëlected secretary.

The North Woburn plant of the New England Chemical Works had one of its buildings blown up and completely destroyed by the subsequent fire early in the morning of Feb. 29. The explosion occurred in the trinitrotoluol department, where explosives for the Allies were being manufactured. According to reports several weeks ago, this was one of the plants marked for destruction by spies.

Chalmers & Williams announce that the New Cornelia Copper Co. of Ajo, Ariz., has just placed an order for twelve 48-in. Symons fine-reduction disk crushers, which will be the only crushers used in its plant to reduce 4,000 tons per day from 4 in. to ¼ in., and also orders for one of the same kind of crusher for each of the following companies: Chile Exploration Co., Hollinger Gold Mines, Timmins, Ont., and C. S. Christensen, Kristiania, Norway.

The Rateau Battu Smoot Co. of New York has recently received orders for: A steam-turbine-driven blower and alternator, 1,900-kw., blower capacity 30,000 cu.ft. at 30-lb. pressure, sea level; also a motor-driven centrifugal blower having a delivery of 24,000 cu.ft. of air at 3-lb. pressure; both these units being for the Cerro de Pasco Mining Co., Peru, and a 24,000 cu.ft. motor-driven blower, delivering air at a pressure of 20 lb. at sea level, for the Braden Copper Co., Chile.

The Bailey Meter Co., 141 Milk St., Boston, Mass., has been incorporated to manufacture and sell a complete line of recording meters and instruments for power plant and other similar uses. These meters have been developed during the past six years in the mechanical engineering department of the Fuel Testing Co. of Boston. The Bailey meters are adapted to accurately measure steam, water, air and gases, under all conditions of pressure, temperature and capacity. They include orifice meters for all fluids in pipes; V-notch weir meters for open flow liquids; "the CO_2 method of steam and water measurement" for meter calibration and testing work; boiler meters showing steam output, rate of air supply and condition of fuel bed; gas flow meters for fan and ventilating ducts; and radimeters for averaging all kinds of chart records.

TRADE CATALOGS

Chain Belt Co., Milwaukee, Wis. Supplement to General Catalog No. 56. Illustrated, 32 pp., 6x9 in.

National Tube Co., Pittsburgh, Penn. Catalog. "Kewanee" Unions and Specialties. Illustrated, 72 pp. 5x8 in.

Sullivan Machinery Co., Chicago, Ill. Bulletin No. 70-A, Sullivan "Rotator" Hammer Drills. Illustrated, 28 pp., 6x9 in.

Stromberg-Carlson Telephone Manufacturing Co., Rochester N. Y. Bulletin No. 1000. Mine-A-Phone. Illustrated, 16 pp., 8x10 in.

Koering Cyaniding Process Co., Detroit, Mich. Pamphlet. "The Highest Development of the Cyaniding Art." Illustrated, 24 pp., 6x9 in.

Nye Steam Pump and Machinery Co., 701-07 N. Western Ave., Chicago, Ill. Catalog No. 14. High Pressure Steam Pumps. Illustrated, 62 pp., 9x12 in.

Editorial Correspondence

SAN FRANCISCO—Feb. 23

The Alaska Graphite Co. is reported as contemplating the installation of a refining plant on San Francisco Bay. The company will ship a large tonnage of this ore from the mines near Teller. At the annual meeting of stockholders the following officers and directors were re-elected: C. H. Philpott, president; H. T. Giddings, vice-president; C. R. Jenkins, secretary-treasurer.

Magnesite Deposits on Land Near Porterville, recently added to the purchase by W. D. Corbin, of St. Louis, are reported to be an extension of the ledge which runs through the Duncan lands and into the Wilcox property included in the purchase. The ore is said to be of equally high grade. Corbin and associates are now reputed to be the largest factors in the California magnesite industry. Other deals are said to be pending for acquisition of additional property.

Agents and Brokers Authorized to Sell Securities of investment companies in California are required to make application to the State Corporation Department for new certificates before Mar. 1. These certificates are good for one year and automatically expire. The fee for agents is $1, and for brokers, $5. Investment companies authorized to sell and own securities are not required to secure new permits; these permits running until revoked or until the securities authorized are disposed of.

The High Price of Quicksilver is seriously affecting some of the big mining companies in California. Some of the mines saw the possibility of extraordinary prices and laid in sufficient supply for a year at prices from $50 to $100 per flask. Those mines which failed to provide against the rise in price, have been obliged to pay from $250 to $300 per flask. Some of the mines have been curtailing their purchases with the idea that the price might weaken; but there is not at present any indication of quicksilver price dropping before it has reached even a higher mark than $300.

Comstock Northend Mines Production was substantially increased in the week ended Feb. 19. The production was of a gross value exceeding $13,000. The Union furnished the largest proportion of the ore, or 369 tons valued at over $10,000. Sierra Nevada produced 94 tons valued at over $2,200. The highest per ton value was from No. 2 stope of 2,500 level of the Union, from which 250 tons were extracted, averaging $35.65 per ton. Sierra Nevada saved 94 tons that averaged $23.75 per ton, from the north end of No. 1 stope on 2,500 level. The average per ton of custom ore crushed in the Mexican mill was $27.80, there being 473 tons whose gross assay value was over $13,000. The Comstock Pumping Association continued extensive drainage operations at all points, the work on airways to improve ventilation, and the reopening of the repaired Sierra Nevada-Mexican-Union shaft, being features of the week.

DENVER—Feb. 25

Vindicator Consolidated Gold Mining Co.'s Annual Meeting, recently held in Denver, resulted in the reëlection of Adolph J. Zang, president; Irving T. Snyder, vice-president and general manager; and Guilford S. Wood, secretary-treasurer; and the election of directors Charles Sigel, Jr., and Adolph F. Zang.

Golden Cycle's Annual Meeting resulted in the election of the following directors: A. E. Carlton, president; E. P. Shove, vice-president; Irving T. Snyder, secretary-treasurer; H. McGarry, general manager; Spencer Penrose, L. G. Carlton and Richard Roelofs. The customary 2c. monthly dividend will continue.

Luema Mining Co., of which Warren F. Page is manager, continues pushing its Valley tunnel into Prospect Mt., a short distance north of Leadville. At about 1,500 ft. from the portal, a number of diamond-drill holes have been driven to explore formations below and about the line of the bore. The rock series here is that typical of the district but locally the measures are so decomposed that cores could not be obtained. It is reported that very satisfactory assays were secured from the materials removed. A winze is being sunk.

Tungsten Prices Continue to Stimulate Demands for properties containing this metal. For certain reasons not made public, buyers in the Boulder field continue to offer higher prices than are offered by buyers elsewhere in the West, or in the East for that matter. Competition nevertheless is keen and as soon as one purchaser announces a raise in his offers, others promptly meet the call. For 60% WO_3 stuff, miners are receiving $60 per unit at this writing, although the latest published price is $57. An interesting development in the tungsten-ore market is the fact that ore running as low as ½% is readily salable to mills, one miner informing the writer that he received $20 per unit for a lot of such ore. Ore running 10% has a published price of $54 per unit but is actually selling for more. So valuable has ferberite become in Boulder County that miners now mention its value per pound instead of per unit.

Portland Gold Mining Co. held its annual meeting, Feb. 21, at Cheyenne, Wyo. The old directors were re-elected, the board consisting of Frank G. Peck, president, Dr. D. H. Rice, Thomas F. Burns, Irving Howbert and Ira Harris. Frank L. Smale was reappointed general manager. Reports from officers showed the net profits from last year's mining and milling operations to have been $783,191. This total was very nearly evenly divided between the main branches of this company's activities, $394,716 from ore production; $388,475 from operating the two mills in the Cripple Creek district and the one mill at Colorado City. During the year the mills treated 426,586 tons of ore. Every mine level contributed ore last year. The deepest level—the 18th—is at 1,870 ft. The 200 level is given over entirely to leasers. To date, the Portland-Independence has produced 3,653,969 tons of ore of a gross value of $64,426,370. The two mines have been worked continuously for 23 years and have more than 55 mi. of underground workings. Estimates place the available tonnage of low-grade ore broken in old workings and lying in the dumps at more than 12,000,000 tons. All waste is now used in backfilling. President Peck's report stated that the price of $325,000 paid for the Independence mine last summer was far below the construction costs of the surface buildings, including the 350-ton mill. This cyanide mill is being altered into a flotation plant of 1,000 tons capacity and when this is in operation the company will be able to treat 2,000 tons of low-grade ore daily.

BUTTE—Feb. 22

The Fire in the Pennsylvania Mine of the Anaconda, by which 21 miners lost their lives on Feb. 14, was the worst mine disaster in the history of Butte. The cause of the fire may never be known, but it is certain that it did not result from an extension into the Pennsylvania mine of the fire which has been burning for some years in some of the neighboring mines. That fact has been fully ascertained. Not the slightest evidence has been found that the fire was of incendiary origin, a sensational theory circulated and evidently based on the fact that the Anaconda company has a large copper contract with the British government. Daniel Harrington, in charge of the Rocky Mountain district of the United States Bureau of Mines, investigated the fire and came to the conclusion that it probably was started by a miner's candle. The fan in the air shaft, he said, which carried 55,000 cu.ft. of air into the shaft and workings, made the timbers dry as tinder. The placing of a candle on the timbers, a spark, or possibly a short circuit, could have started the fire and the fans converted it into a blaze in a few minutes. Mr. Harrington said: "My investigation also showed that first aid is better developed in the Butte district than at any other place in the West, and the Anaconda company, to my mind, was guilty of no act of commission or omission in connection with the disaster. I found that the company's rescue equipment and rescue organizations are so complete that the assistance of the Federal rescue cars were not needed, although our bureau promptly made such offer. The mine was made as safe as mines can be made." On Feb. 17 the fire broke out anew on the 1,200-ft. level and extended into some of the stopes. A large fire-fighting force put in cement bulkheads to prevent a spread of the fire and to smother the flames. There was danger that the fire would get into the ore and add another burning mine to the Anaconda list. A similar fire broke out on Nov. 23, 1889, and has been burning ever since in the Anaconda and St. Lawrence mines. Another has for some years been burning in the Colusa and Tramway. The burning areas in those properties are confined within cement walls, but occasionally the fire burns through at unexpected places and is a more or less constant cause of danger and anxiety.

SALT LAKE CITY—Feb. 25

The Decision of the Federal Court of Utah in the litigation between the Silver King Coalition Mines Co. and the Conkling Mining Co., both of Park City, over the Elephant stope of the Conkling claim—in which the Coalition company owns a one-fourth, and the Conkling company a three-fourths interest—has been reversed by the United States court of appeals; and the case sent back to the federal court here for the assessment of damages to be paid the Conkling company. The latter company claimed that the Silver King had mined ore to a value of $575,000 from the Elephant stope, which rightfully belonged to it, contending that the Conkling claim was 1,500 ft. long and 600 ft. wide, and bringing an injunction and accounting action against the Coalition company. The defense was that the Conkling claim had been incorrectly surveyed, and that the 129 ft. containing the Elephant stope belonged to it. Former Judge John A. Marshall in his decision gave the Elephant stope to the Coalition company on the ground that the 129 ft. of the north end of the Conkling claim belonged to the Coalition, and on the further ground that it was entitled to extra-lateral rights. An appeal was taken to the circuit court, which reversed the judgment, finding that the Silver King Coalition had no claim on the 129 ft. The circuit court further found that the Elephant stope was not included by extra-lateral rights of the apex of the Silver King vein, and awarded mining rights of the Elephant stope to the Conkling company. Since the Silver King owns a one-fourth interest in the Conkling claim, one-quarter of the ore taken from the Elephant stope will be deducted. It is thought that damages will be assessed at the next session of the federal court.

By Statements Made to the State Board of Equalization for assessment purposes, the net proceeds of two Park City mines during the year recently ended are shown to have been: Daly-Judge, gross earnings, $1,041,413, net proceeds $500,699; Silver King Consolidated, gross earnings, $615,173, net proceeds, $359,530.

DOS CABEZAS, ARIZ.—Feb. 12

Power Plant Destroyed by Incendiarism is the bad news recently forwarded to the stockholders of the Mascott Copper Co. by President T. N. McCauley. The buildings were constructed with corrugated iron roof and walls over a wooden framework, while the floor was of concrete. Three minutes from the start of the fire the building was a mass of flames. That the rapidity of spread of the flames was due to thoroughly arranged incendiarism is the charge freely made in the letter. The company was almost on a profitable basis and the burning of the power plant at such a time of high-priced copper is peculiarly unfortunate. A new power plant is under construction and one engine, only slightly damaged, will be running inside of 90 days.

MORENCI, ARIZ.—Feb. 25

The Clifton-Morenci-Metcalf District has already regained its pre-strike prosperity—and a little more, perhaps. Feb. 21 was payday and everybody drew a big check. The conference between the managers and the Grievance Committee is at a standstill.

Shortage of Railroad Cars is hampering mining in Arizona which also is suffering from the inability of the smelters to handle the ores. The smelteries at Hayden, Humboldt, Clarkdale and Douglas are running at full capacity and hundreds of carloads are being shipped to El Paso. It is reported there are over 100 cars continually standing in the yards at the Hayden smeltery and similar conditions prevail at the other plants.

Mining in Northern Sonora is said to be picking up. Mexicans are swarming into the larger camps from the south and many Americans are seen on the roads and trails to the outlying districts. Work on the Archipeligo mines, east of Cumpas, has been started since the arrival of manager Boyd from Chicago. The Transvaal mines, which are owned by the Anheuser-Busch people, are commencing operations. Mr. Christie is resuming work at the Esquadro, east of Moctezuma. Sixty carloads of lead and zinc ores were imported through Jauraz from northern Durango and southern Chihuahua one day last week. This denotes some improvement in the paralyzed transportation facilities.

WALLACE, IDAHO—Feb. 22

Increased Wages due to high prices for lead are announced by the following mining companies: The Federal, Gold Hunter, Hercules, Marsh, Consolidated Interstate-Callahan, Tamarack & Custer, Success and Hecla. The notice of increase reads as follows: Until further notice, when lead is selling above $5 per cwt., the following additions will be made to the regular daily wage now being paid: Twenty-five cents per shift when lead is above $5 per cwt. and not above $5.50 per cwt. Fifty cents per shift when lead is above $5.50 per cwt. and not above $6 per cwt. Seventy-five cents per shift when lead is above $6 per cwt. and not above $6.50 per cwt. One dollar per shift when lead is above $6.50 per cwt. The average price of lead for any month as published in the "Engineering and Mining Journal" will govern the wage paid for the following month.

HELENA, MONT.—Feb. 21

A Petition in Bankruptcy Was Filed in the Federal Court against the Northwestern Metals Co. by the Helena Light and Railway Co. and others, all of Helena. Petitioners believe there are 45 creditors whose claims aggregate $50,000. Company was organized some years ago to treat all kinds of ores by a new leaching process and a costly plant was installed at Helena for that purpose. Operating difficulties caused plant to be shut down.

JOPLIN, MO.—Feb. 26

The Bankers Tract of land southeast of Joplin will hereafter be drained by the land owners. This will insure steady operation of its lessees, a condition that has never prevailed since the big pumping plant was closed down many years ago.

In the Webb City Camp, T. F. Coyne paid $25,000 for the mill and lease of Bell & Co. Chapman Bros., of Webb City purchased the fee to 40 acres of mining land in the North Webb City sheet ground district.

The Sale of the Bradley Properties in the Joplin camp was made last week. The Bradley No. 1 was sold to Jess Briegel, of Chicago, who acted as agent for R. R. Conklin. The Bradley No. 2 was sold to the Spiral Mining Co., an Oklahoma corporation, of which Chas. Dudley Pratt is the local manager, and J. S. Mullen, of Ardmore, Okla., is the principal stockholder.

Investments Totaling Over $1,000,000 were made in Joplin district this last week. Most important of these was that of the Kenefick Zinc Corporation with four operating mines as its nucleus of producing properties. These include the Media and Electrical at Webb City and the Coyote and Sampson in Joplin. All these properties are equipped with large mills and are turning out a large tonnage of concentrates weekly. The purchase price of these properties, is not stated. They are among the largest producers in the field. The next important transaction was the purchase of the A. W. C. Mining Co.'s property by Johnson and Gipson, who paid $300,000 for these holdings, consisting of three mills operating upon leases in the West Joplin sheet ground district. These properties have been the largest producers of high-grade zinc concentrates in that part of the Joplin camp for the last year. Another sale of considerable importance is that of the McDonald mine at Prosperity, sold to Aiken, Curtis & Cosden for $175,000. The property has a mill of 350 tons capacity on the Connor land. At Springfield, Mark R. Chartrand, of St. Louis is reported to have paid $125,000 for the Gem Mining Co., located in the Jumbo District south of Springfield.

TORONTO—Feb. 26

The Imperial Privy Council has rendered an important decision affecting the incorporation of Canadian companies. The Federal Government contended that a company incorporated by a Provincial government had no right to do business in another province without taking out a Dominion charter. This contention was upheld by the Supreme Court, but the appeal taken from that decision has been sustained by the Privy Council.

The Proposed Tax Legislation as affecting the mining industry of Ontario is likely to meet with a good deal of opposition, and as far as is known at the present time the Minister of Finance appears to be open to suggestions that will help to make the tax more equitable. The new tax is particularly objectionable to the mining companies on account of the low rate of interest allowed before the tax becomes operative. Seven per cent. return is a low rate of interest on any mining stock and particularly so in Canada where the mining industry is not so firmly established as in some other countries, and where there are only a few mines having a known life of any considerable length. The general feeling seems to be that a straight tax on all profits irrespective of the capital of the company would be more equitable. Under the present proposed arrangement, the Hollinger would be the hardest hit of any mining company, and its tax would amount to about $1,000,000 for the two years. Another company that would suffer is the Brittania Mining and Smelting Co. in British Columbia. The issued capital is only $1,650,000 as compared with the Granby, having $15,000,000, and it is probable that the profits of the two companies for the present year will be about the same. There has been an insistent demand for the production of gold, and the proposed tax would probably have the unfortunate effect of decreasing the production of this much-needed metal.

The Mining News

ARIZONA

Cochise County

SHATTUCK ARIZONA (Bisbee)—Production for the month of January: Copper, 1,565,224 lb.; lead, 267,853 lb.; silver, 30,369 oz.; gold, 534 oz.

MASCOT COPPER (Wilcox)—Another strike on 200-ft. level; runs as high as 30% copper; announced by company.

Gila County

BUSH AND CRAWFORD (Miami)—Together with number of Swedish miners reported taking out tungsten ore from claims in Powers gulch, west of Miami, at the rate of $50 a day per man; said to have $30,000 worth ore on dump.

DICKSON ZINC (Miami)—Charles Dickson has leased his zinc mine in Powers gulch to Denver investors, who are already taking out ore for shipment. Zinc running 40% will be shipped; lower grades will be held for concentrating. Dickson has opened up 18-ft. vein for a distance of 50 ft.

INSPIRATION COPPER (Miami)—Operation of 600-ton test mill, which has been running since early in 1914 and in which feasibility of flotation process for treatment of Inspiration ores was demonstrated, has been discontinued and plant will be torn down to eliminate danger of fire to overhead railway trestle.

Graham County

GRAND REEF (Klondyke)—New concentrator of Laurel Cañon now in operation; capacity, 250 tons. Company has 600,000 tons blocked out; thirty-five men employed.

Mohave County

MERRITT (Oatman)—Merritt group in northern part Tom Reed section purchased by C. S. Sprague, of Goldfield.

SUNSHINE (Oatman)—Sunshine group, locally known as the Hackberry, taken over by Phillip Wiseman and Seeley W. Mudd.

UNITED EASTERN (Oatman)—Lateral explorations on new 665-ft. level have disclosed the main ore body, which was proven for distance of about 650 ft. on the 465- and 565-ft. levels.

WILLIAMS TUNGSTEN (Yucca)—Milling plant will be installed to treat milling ore in sight. Mine also contains high-grade ore, some running as high as 70% tungsten. Recent shipment to Pennsylvania brought $3,500 a ton.

CARTER GOLD MINING (Oatman)—L. D. Lackey, representing Philadelphia investors, has purchased large interest. Lateral work on the 250-ft. level suspended after completely crosscutting main vein. Shaft being equipped to continue sinking to 500-ft. point.

BIG JIM (Oatman)—Sinking operations resumed after 2 weeks' delay caused by sudden inflow of water at 445-ft. point. Water handled by station and sinking pumps, run with air obtained from Black Eagle shaft plant of the Tom Reed. New 700-cu.ft. compressor ordered will furnish air for pumps and 6 machine drills; shaft will be continued down to 600-ft. point.

MOHAVE-OATMAN WATER CO. (Oatman)—Capitalized for $1,000,000, to put water project and sewerage system in Oatman Mining District, to cost between $250,000 and $300,000. Water will be pumped from wells on east bank of Colorado River, through 10-in. pipe, to an intermediate reservoir of 2,500,000 gal. capacity, a distance of nine and one-half miles. From this point an 8-in. pipe will be run through various townsites to main reservoir in Oatman. The officers of the company are: Daniel Cahill, president and superintendent, E. Pritchard Smith, vice-president and general manager, D. L. Mayhew, secretary and treasurer. Will be ready to let contracts within 90 days.

Pinal County

RAY HERCULES COPPER (Ray)—Plans made for big crushing plant on property at north end of town of Ray, also for concentrator at Kelvin, 6 mi. south of Ray. Machinery for big hoist is on ground and deep shaft will be sunk on Grace L. claim. Several churn drills have been proving Ray Hercules ground for some time and will be kept going indefinitely. Railroad spur will be constructed from Ray & Gila Valley railroad to center of Ray Hercules property.

Yavapai County

UNITED VERDE EXTENSION (Jerome)—Crosscut on 14th level has penetrated ledge for 85 ft. averaging 15% copper throughout. No sign of wall in sight.

TIP TOP (Crown King)—Reported that George Wingfield, of Nevada, associated with Chas. M. Schwab, Pittsburgh, is negotiating for old Tip Top mine. Two detailed examinations of property have been made by E. A. Starr, Wingfield's engineer. New mill has been in operation for over a month, making tests from old dump and every level in mine. Estimated $3,000,000 tungsten ore in sight; also carries silver.

STODDARD MINES (Stoddard)—Company and Copper Queen Gold Mining Co. have organized corporation to construct and operate $50,000 joint flotation mill at Stoddard, according to C. M. Stoddard, principal stockholder of Stoddard. Each company takes half stock. Millsite surveyed and wagon road will be built from Humboldt or Mayer. Mill expected to operate within 5 months; development in both mines to be resumed at once. Investors at Paris, Tex., control Copper Queen; New York capitalists are associated with Stoddard.

CALIFORNIA

Calaveras County

EASY BIRD (Mokelumne Hill)—Exploration and development carried on by International Investment Syndicate of Los Angeles. More than $25,000 expended in reopening mine and developing orebodies. Electric power transmission line from Pacific Gas and Electric Co. power plant, situated on opposite side of Mokelumne River from mine, just completed. Milling capacity will be increased and modern electric hoist and air compressor will be installed.

Eldorado County

ROCKY BAR (Coles)—Property will be reopened by M. P. Server under bond. Machinery for hoist and other equipment will be installed.

Shasta County

MAMMOTH (Kennett)—Mineral claims of Kennett Water Co. have been purchased; price, $75,000. Exploration and development will begin as soon as weather clears. Heavy snow storms did not interfere with 5,000-ft. main lower tunnel of Mammoth, designed to tap orebodies 400 ft. below present workings. Production of copper continues to exceed 600,000 lb. per month, including Balaklala ores. Zinc production is about $90,000 per month.

Sierra County

SIXTEEN-TO-ONE (Alleghany)—Another pocket of high grade just extracted. Twenty men employed under Supt. M. Sullivan.

KEYSTONE (Sierra City)—Nine men breaking ore in stopes. Mill plating $10 per ton, gold. Bonded to Bigelow and Gilbreath.

SACRED MOUNT (Sierra City)—Winze being sunk to get under ore assaying $8 per ton on surface. Under lease to A. Church and associates.

CLEVELAND (Sierra City)—New Ingersoll compressor installed, shaft sunk 350 ft., and 10-stamp mill running. Extensive exploration work to be continued by Gillespie and McGonigle, of Pittsburgh, Penn., with 25 men now employed.

IRELAND (Alleghany)—Another rich deposit encountered in upper tunnel, 860 ft. from mouth. Lower tunnel will be extended to tap orebody at depth, and other development prosecuted upon extensive scale. K. K. Ash, engineer in charge.

KLONDIKE (Sierra City)—Snowsheds erected early in winter have permitted continuous work. Drift has been run 240 ft. and will be extended 100 ft. farther to tap channel. Eight men employed and more will be added with opening of spring.

MUGWUMP MINES CO. (Alleghany and Forest)—Recently organized to develop several known rich properties in this district, including the Gold Star and Young America which contain both gravel and quartz and were among the richest producers in early days of drift mining. A. D. Foote, superintendent of North Star of Grass Valley, will be president and manager. L. P. Larue, A. H. Tickell, Wm. Hague and C. E. Clinch, of Grass Valley, and S. L. Bright, of San Francisco are also among the organizers.

Siskiyou County

LARGE CHROME DEPOSITS recently discovered within a mile of Yreka, at Butcher Hill. Ore is said to have been tested by engineers and proved to be of good quality. Hanging-wall vein carries some gold.

CALIFORNIA-OREGON POWER CO. contemplates installation of dam on Klamath River, at Copco. Cost said to approximate $500,000.

McKEEN (Callahan)—C. G. Strickland, manager of Denny-Bar Co., and James McKeen, visited Yreka recently and arranged for final payment on McKeen mine, recently purchased by McKinney. Stated that property will be developed on large scale.

Trinity County

GOLDEN JUBILEE (Carrville)—Exploration tunnel has been started, designed to tap ore deposits at an approximate depth of 900 ft. below present workings. In lower levels large bodies sulphide ores have been disclosed and veins indicate persistence to great depth. New reduction plant will be installed as soon as weather permits. Entire country is practically snowbound. New tube mill and cyanide plant also contemplated. Property is equipped with 10-stamp mill. John C. Boddiker is superintendent and California Extraction Co., of San Francisco, owner.

Tuolumne County

CLIO (Jacksonville)—Reported that property will be reopened by Oro Mining Co. Formerly developed by 800-ft. tunnel and 400-ft. shaft. Equipped with 10-stamp mill in good condition. Was former producer.

POISON OAK (Sonora)—South American Development Co. has started work under bond and lease. Property idle several years. Developed by 300-ft. shaft and 3 drifts, all said to be in pay ore. Large amount of ore was treated in 5-stamp mill, but sulphide ores in bottom were not successfully treated because of lack of methods. Property situated north of Bostater Ranch in Blanket Creek district. J. W. Mercer, of New York, is general manager. W. H. Knowles, superintendent.

DELAWARE

PYRITES CO., LTD. (New York)—Company contemplating land purchase on Delaware River near Wilmington, Del., for establishment of plant to agglomerate pyrites cinder into an iron blast-furnace material, as now done at its Roanoke, Va., plant. Manufacture of acid, as reported, is not contemplated.

IDAHO

Shoshone County

CALEDONIA (Wallace)—January net earnings $100,264 from shipment of 893 tons concentrates and 547 tons ore of gross value $149,314.

INTERSTATE-CALLAHAN (Nine Mile)—Net earnings for January $375,000, shipments of crude ore and concentrates, both lead and zinc, having been approximately 6,000 tons.

HYPOTHEEK (Kingston)—Directors at a Wallace meeting, decided to erect a concentrating mill of 150 to 200 tons capacity at mine, also install double-drum electric hoist. Will ultimately build mill of larger capacity at Enaville on railroad, 3 mi. away, connected with mine by aërial tram. Mill at mine will be built soon as plans are prepared. Expected that ore now available will provide funds for further development of mine and all construction of permanent mill and tramway.

AMAZON-DIXIE (Sildix, Montana)—Property situated just across state line, with this city its supply point. Lower tunnel has demonstrated shoot of commercial lead ore 600 ft. long, averaging 6 ft. in width. Raise recently completed to No. 2 tunnel, 500 ft., on vein with more or less ore all the way. Station now being cut near raise for hoist, when vein will be explored by shaft and drifts to a depth of 500 ft. If showing proves satisfactory this work will be followed at once by erection of mill. Cleveland capitalists are heavily interested.

SECURITY CEMENT AND LIME CO. (Hagerstown)—Has completed arrangements for projected plant to recover potash from waste gases of cement kilns. Will use Cottrell process; expects to save approximately two tons of potash daily. Cost of plant estimated at $50,000.

MICHIGAN

Copper

CHAMPION (Painesdale)—Preparing to regrind all of its tailings. Number of Wilfley tables will be doubled. Manganese-steel balls successfully used to replace Danish pebbles in Hardinge mills, pebbles being impossible to obtain on account of the war. Eventually all of regrinding machinery at all of Copper Range mills will be handled by electric turbines now being installed at Champion to be operated by exhaust of Champion stamps.

MINNESOTA

Cuyuna Range

CUYUNA RANGE POWER CO. will construct auxiliary steam plant at Riverton, Minn., to meet heavy power demands on Range. Company about to begin construction of power dam on Crow Wing River some miles west of Brainerd.

CUYUNA-SULTANA (Ironton)—Special stockholders' meeting recently held to take action on proposed consolidation of Cuyuna-Sultana and Hopkins properties, latter controlled by Breitung interests. Committee appointed with authority to act.

Duluth

MINNESOTA STEEL CO. (Duluth)—Second blast furnace blown in Feb. 18, bringing plant to its maximum production of pig iron.

UNIVERSAL PORTLAND CEMENT CO. (Duluth)—Fires started in the dryers Feb. 16, constituting initial operation at new plant.

CARMAN CONSOLIDATED COPPER (Duluth)—Reorganized into new company, called Maria Mining Co., capital $500,000, par $1. All legitimate issue of old Carman shares will be exchanged on payment of 10c. per share. Mine located in Sonora, Mexico. Product, silver. Practically all stock held in Duluth and on Mesabi Range.

Mesabi Range

KINNEY (Kinney)—Mining operations discontinued for winter and entire crew put on repair work.

SHENANGO (Chisholm)—New steel headframe completed. Full crew of men working underground again. The pit will be opened Apr. 1.

MACE (Nashwauk)—Stripping is about completed. About 300,000 tons of ore sold for 1916 delivery. It will be mine's first year as shipper. It is here that big steam shovel, weighing 315 tons, is being used.

HAWKINS (Nashwauk)—Fifty men are employed in shops making repairs to machinery. Company expects to put 1,200,000 tons of wash ore through mill this year. There are 18 double-deck concentrating tables in mill.

OLIVER IRON (Hibbing)—Forty new stripping cars have been ordered; cost, $2,000 each. Have a 20-yd. sweep, as compared with 7-yd. cars now in use. Their capacity will be 35 tons. Will be largest stripping cars on range. Delivery will be made in March.

GLEN (Chisholm)—Fires of incendiary origin have occurred three times recently in underground workings. Last one, in abandoned portion on 84 ft. level threatened to become serious but was finally extinguished; men used Dræger smoke helmets.

Vermilion Range

SIBLEY (Ely)—Cave in on Feb. 14 imprisoned two miners on the 5th sub-level. Caused by timbering giving way. Men rescued after six hours.

MONTANA

Silver Bow County

DAVIS-DALY (Butte)—Shipments largely increased due to opening of three-compartment shaft to 2,500 level, in Colorado mine. Development work on 2,500 level said to be satisfactory.

NORTH BUTTE (Butte)—Annual report discloses copper content in the ore has fallen from 54.6 lb. in 1914 to 50.8 lb. in 1915. Costs of mining were reduced from 11.5c. per lb. to 10c. per lb., about highest cost in district.

TUOLUMNE (Butte)—Question of increasing capital stock from $800,000 to $2,500,000 for purpose of purchasing additional property comes before annual meeting Butte, Mar. 30. Properties under consideration are Colusa-Leonard extension group and the Butte Main Range properties. Part of Butte Main Range is now under control of North Butte company.

BUTTE & ZENITH CITY (Butte)—The unwatering of shaft in Nissler district nearly completed and Supt. Gibson has a force installing new machinery, including large compressor and electric pump of ample capacity to keep the mine dry. Expect to begin sinking soon and present plans call for the reaching 1,000 level by Apr. 1. Crosscut will then be run to vein.

PILOT-BUTTE (Butte)—Special meeting of stockholders is called for Mar. 30 for purpose of ratifying sale of company's property to Anaconda company. Definite details of sale lacking, but price reported close to $1,100,000, the equivalent of $11 per share after all outstanding obligations are adjusted. Before Mar. 30 final arrangements for transfer of property will be made.

ALEX SCOTT (Butte)—Official announcement made that the Anaconda company has purchased the Butte-Alex Scott Co. for $750,000. Purchase includes Little Annie, silver property, in northern part of Butte district, and 500 ft. of Alex Scott claim, adjoining West Colusa mine and on which is plant of Butte-Alex Scott Co. Deal was closed at a meeting of Butte-Alex Scott stockholders held in Duluth. Company shares held largely in Butte, Duluth and Pittsburgh.

EAST BUTTE (Butte)—Since Anaconda company took over Butte-Alex Scott mine and diverted ore from there to Washoe smeltery, Pittsmont smeltery is treating its own ores only, resulting in shutting down of one of two blast furnaces. New flotation plant is handling about 600 tons tailings per day. Reported East Butte contemplating installation of sulphuric-acid plant at Pittsmont smeltery to supply own needs and sell surplus.

ANACONDA (Butte)—Unwatering of Emma mine is practically completed. Sinking will commence as soon as new machinery is installed. New boiler house with four boilers ready for operation. Diamond drilling on Czarroma claim, adjoining Emma, said to have located a zinc vein 60 ft. thick. With beginning of sinking operations on Emma, crosscutting from Original mine on 1,500-ft. level will be rushed speedily as possible. When zinc concentrator at Anaconda is ready, Emma will be shipper.

BUTTE & SUPERIOR (Butte)—Report for quarter ended Dec. 31, 1915, shows operating results as follows: Dry tons of ore milled, 150,150, with average zinc content of 16.66%. Zinc concentrates produced, 44,344 tons with 53.63% zinc, making a total of 247,563,144 lb. of zinc produced. Mill recovery, 95.07; mining costs, $3.54; milling costs, $1.59 per ton. Tonnage treated during quarter was greatest of any similar period in history of company. Report for January, 1916, filed in Federal Court Feb. 19, shows that from 49,429 tons of ore 10,535 tons of concentrates were recovered in oil flotation plant valued at $101.16 a ton, at a cost of $3.05 a ton.

NEVADA

Esmeralda County

C. O. D. CON. (Goldfield)—Contract signed for 150-ton flotation plant to cost about $30,000. Is to be erected by Ellsworth & Morris, leasers, and the company will receive a flat royalty of 15% minus the smelter charges on the concentrate. Louis Koontz is manager.

Humboldt County

SEVEN TROUGHS COALITION (Seven Troughs)—New find on 1,500 level in north drift from Bird Winze reported to have widened to 18 in. of $500 ore. Sinking has been resumed with 1,600 level as objective and now at 1,500 ft. Date of next quarterly dividend of 2½c. per share moved forward to Apr. 1.

Lincoln County

HOMERUN COPPER (Pioche)—Company proposes to place power equipment for further development and increase present working force.

Nye County

TONOPAH ORE PRODUCTION for week ended Feb. 19 was 8,700 tons valued at $181,860, compared with 8,404 tons for week previous. Producers were: Tonopah Belmont, 3,102 tons; Tonopah Mining, 2,025; Tonopah Extension, 1,800; Jim Butler, 700; West End, 550; Halifax, 90; North Star, 53; miscellaneous leases, 380 tons.

JIM BUTLER (Tonopah)—January production amounted to 4,682 tons; yielded net profit of $28,745. Last annual report gave ore reserves at 40,310 tons with a considerable area yet to be prospected and developed.

TONOPAH BONANZA (Tonopah)—Shaft down 1,160 ft., sinking by contract with 1,500-ft. level as objective where lateral will be started. Stated company has acquired Desert King Co.'s group of claims south and east of Bonanza property.

TONOPAH BELMONT (Tonopah)—During January 12,863 tons treated from which 2,545.61 oz. gold and 239,681 oz. silver recovered. Profit, $86,564, compared with $80,135 for December. Stated company has option on Bull Moose property near Beatty, Nye County, Nevada.

TONOPAH MINING (Tonopah)—During January 7,413 tons mined and treated averaging $13 per ton. Profit for month, $27,270. Besides development of own ground company actively engaged prospecting, under options, property of California & Tonopah and Mizpah Extension.

MACNAMARA (Tonopah)—Arrangement being considered whereby company may work through West End shaft and workings to prospect recent find made by the latter company near the MacNamara line. Would mean resumption of work by MacNamara with possibility of again entering list of producers.

Storey County

ANDES (Virginia)—Saved 16 tons of ore in stoping above intermediate level.

SIERRA NEVADA-MEXICAN-UNION (Virginia) — Joint shaft reopened 15 ft. to 175 ft. point below 2,000 station.

SIERRA NEVADA (Virginia)—Saved from No. 1 stope on 2,500 level, 94 tons, averaging $23.75 and of gross value over $2,200. Low grade ore continues in bottom of winze in No. 1 stope.

UNION (Virginia)—Ore extraction for week 369 tons, gross value exceeding $10,000, from: 2,500 level No. 2 stope 250 tons, $36.65; 2,400 level No. 4 stope 119 tons, $13.90. North drift 2,700 level reopened and repaired 20 ft.

OPHIR (Virginia)—Saved 327 cars ore from stope on 250 level Central tunnel and milled 290 tons. Repairs made on tunnel and 250 level. Consolidated Virginia joint west crosscut on 2,700 level, through porphyry and stringers of quartz, reached 361-ft. point.

CROWN POINT-BELCHER (Gold Hill)—Saved 10 cars of ore from 1,600 level No. 2 stope and 35 cars from north drift No. 2. Repairs to joint incline, Jacket shaft and incline, and on 1,400 level. Jacket mill received 186 tons mine ore and 490 tons dump rock; shipped 1 bar of bullion.

MEXICAN (Virginia)—Cleaning out old east crosscut on 1,600 level, for inspection, to the incline winze. Prospecting crosscuts on 2,500 and 2,700 levels show porphyry and quartz of low assay. Mexican mill crushed 473 tons custom ore averaging $27.80 and of gross value over $13,000.

NEW MEXICO

Dona Ana County

PHELPS-DODGE (Organ)—Company has taken option on Bennett-Stevenson, Torpedo and Memphis mines in vicinity of Organ.

MERRIMAC (Las Cruces)—Mine, which has been idle for some 12 years, is now being operated by Martin Fishback and associates, of El Paso and Mexico. A 5-ft. vein, carrying 30% zinc, 3% copper and 4 oz. silver per ton was developed to depth of 250 ft. under old regime, and it was thought to be main orebody. Examination of property, however, opened up orebody 25 ft. wide and extending 1,000 ft. along contact, running 40% zinc, 3% copper and 4 oz. silver. Large force of men already employed is being gradually increased. Large shipments of high-grade zinc ore will start at once to Kansas and Oklahoma smelters. Concentrating plant to handle large tonnage of medium- and low-grade ores will be installed at an early date. Merrimac is located on granite-porphyry and lime contact, near northeastern boundary of the mineralized zone in Organ district, 17 mi. northeast of Las Cruces. E. G. Rice, formerly manager of Excelsior mine in same district, is superintending the work.

Lincoln County

LITTLE MACK (White Oaks)—Tungsten discovered in the Little Mack.

Sierra County

CABALLO MOUNTAIN (Las Palomas)—New organization of F. G. Smith, El Paso, to take over property formerly owned and worked by Victorio Chief Copper Min. & Smelt. Co., about 15 mi. west of Cutter. Force of 20 men will be increased at once; ten 4-horse teams hauling ore to nearest railroad station, Cutter; nothing under 8% copper shipped. Orebodies of Marion partly oxidized, partly chalcopyrite; Oohoo contains oxidized copper, said to run $3 to $4 in gold and silver.

TEXAS

Reeves County

SULPHUR (Toyah)—C. V. Plummer, of Beaumont, has purchased machine and employed expert sulphur drillers to put down string of holes about 300 ft. deep. Near Maverick Springs, holes already sunk 40 ft. in continuous sulphur ground. El Paso men also looking over field in company with Prof. J. C. Carrera, geologist.

UTAH

Beaver County

MOSCOW (Milford)—In addition to its lead-silver ore the mine has zinc ore blocked out ready for mining. Good showing zinc ore on the 200-ft. level. Cullen shaft is down 1180 ft., and new electric hoist operating satisfactorily.

Salt Lake County

LOGGER (Salt Lake)—Tunnel has reached limestone-quartzite contact, encountering some mineralization. Property is in Big Cottonwood.

ALBION (Alta)—Work in mineralized ground being done in two places: 600 ft. southeast of the cave and in raise northwest of cave. Raise is up 110 ft. in ground heavily mineralized.

SOUTH HECLA (Alta)—Connections made between 250 and 500 levels by means of three raises, affording better ventilation and more advantageous handling of the ore. The 500 is main level of the mine. Shipments of 200 to 300 tons weekly being made. Wedge orebody on 250 is opening up well carrying silver and lead.

Summit County

SILVER KING (Park City)—New strike made east of shaft. Ore is making on the limestone bedding, and runs high in silver.

THREE KINGS (Park City)—Drift on 540 level out 508 ft. from shaft, being driven southeast. Banded quartz encountered between two fissures. Face in limestone. W. R. Elliot is manager.

NEW QUINCY (Park City)—Development being done at three points to locate the Daly-Judge and Daly West ore channels. Milling ore found in the Thompson-Quincy fissure on the 1,200 level.

Tooele County

QUEEN OF THE HILLS (Stockton)—New hoist will be installed soon as can be hauled from Stockton. Zinc carbonate of good grade being mined by Big Four Exploration Co.

O. K. SILVER (Faust Station)—Forty tons ore running well in silver shipped. Mine is in Stansbury range about half way between West Tintic and Grantsville. More ore is broken for shipment. W. G. Lamb, of Salt Lake, is secretary.

DETROIT MINING (Oasis)—Property in the Drum Mountain copper district has three cars of ore for shipment. Some of ore runs high in copper, carrying a little gold. About 13 men employed. The Copper Head and Laird properties adjoining Detroit are being worked.

KEARSARGE (Stockton)—Property in Dry Cañon under lease to E. A. Taylor and associates, being put in shape for development. Inclined shaft is down 1,500 ft. and some ore exposed in drifts. Stope fillings are to be sorted over, with intention to make property pay for development.

WISCONSIN

Zinc-Lead District

ST. ANTHONY (Highland)—Harris Lewis has purchased this property, 3 mi. south of Highland, and will commence operations at once.

DICKINSON (Platteville)—Valuable discovery of lead and zinc ore made by churn drill on George Dickinson's land within the city limits of Platteville.

MINERAL POINT ZINC CO. (Mineral Point)—Is constructing Clark mill No. 2, at Highland, and has completed new Skinner type roaster at Mineral Point.

MULCAHY (Shullsburg)—Interests affiliated with Oliver Mining Co. building a 400-ton mill and roaster on the John Mulcahy land at Shullsburg. New shaft down 140 ft. said to have penetrated 80 ft. of jack ground. This property was proved with diamond drill 10 years ago.

CANADA

British Columbia

ALICE ARM (Anyox)—Reported crosscut tunnel tapped good width ore averaging 10% copper at depth of 125 ft. Property owned by Thaddeus S. Lane, Frank T. McCullough and Walter Nicholls of Spokane.

ONTARIO

ACME (Porcupine)—Fire destroyed dry house.

NORTH THOMPSON (Porcupine)—Preparing plans for new mill.

WETTLAUFER (South Lorraine)—Has been leased to Cobalt men.

RAND SYNDICATE (Porcupine)—Will install plant in Deloro Township.

KERR LAKE MAJESTIC (Cobalt)—Mine was sold at auction Feb. 15 for $5,000.

CROWN RESERVE (Cobalt)—Has taken option on McCrea properties, Boston Creek.

TECK HUGHES (Kirkland Lake)—Will have new mill in operation in about three weeks.

MILLER INDEPENDENCE (Boston Creek) — Installing mining plant and 10-stamp mill.

PETERSON LAKE (Cobalt)—Has taken option on Reliance property adjoining the Nova Scotia.

HAYDEN (Porcupine)—Shaft down 100 ft. Good orebody encountered in crosscut.

TRIUMPH (Porcupine)—Contract let to Henley & Badger to continue shaft down to 215 ft.

MIRACLE (South Porcupine)—Hardinge mill will be installed to replace mill destroyed by fire.

ANCHORITE (Porcupine)—Property in Deloro Township optioned to interests associated with Coniagas Mine in Cobalt.

EMPIRE STATE (Porcupine)—Is the name of new company organised to work Pike Lake properties, Deloro Township.

DOME LAKE (Porcupine) — Production for year $106,941 from 11,727 tons ore averaging $9.12. Extraction by amalgamation and concentration 79.9%. Total operating costs $6.19 a ton.

TRETHEWEY (Cobalt)—Directors announce mine will be reopened. Operations stopped February, 1915, with profits for year only $6,452. Cash on hand is $59,000. Ore in sight estimated to contain 507,229 oz.

GYGES (Porcupine)—Three Nations and La Palme properties taken over by this company recently organized with capital of $2,000,000. Mill with capacity of 120 tons per day will be erected.

HOLLINGER (Porcupine)—First four-week period this year mill treated 30,817 tons ore averaging $9.30; making gross profit $174,996; a decrease of $45,083 compared with preceeding period. Operating costs were $3.13. Mill ran 94.7% of total time; treated a total of 43,663 tons of which 30,817 Hollinger and 12,846 Acme. Surplus now $1,533,206.

SOUTH AMERICA

Colombia

PATO MINES, LTD. (Zaragosa)—Dredge shut down on Jan. 31 for 5 or 6 weeks for general repairs, including new buckets; last cleanup, $22,055 from 64,639 cu.yd. dug in 13 days.

ASIA

Chosen

ORIENTAL CONSOLIDATED (Unsan)—Reports for month of December, 1915, a total of 29½ days running time with 200 stamps crushing 26,261 tons. Gross receipts for month, U. S. gold, $147,865.58; operating costs, $84,424.95; operating profit for the month, $63,440.63; put back into improvements and development, $6,114.62; net profit over all expenditures for December, 1915, U. S. gold, $57,326.01.

The Market Report

Metal Markets

NEW YORK—Mar. 1

The spectacular features of the last week were the sharp advances in lead and tin, both of which markets were sensationally active. On the other hand, the markets for spelter and copper, especially the latter, were dull and weakish.

Copper, Tin, Lead and Zinc

Copper—Scarcely any business worth mentioning was done by producers during the last week. The few sales that were consummated were chiefly in the early days, after which the market became increasingly dull. The principal producers viewed this with unconcern, their order-books being already so full, and maintained their previous price of 27¼c., r. t., admitting that copper was available from other quarters for less. In fact, copper was offered from other quarters at material concessions, the premium for early deliveries completely disappearing. It was not, however, easy to find buyers, most of whom are supposed to have covered their immediate requirements. At the close, copper for April delivery was offered from several quarters at 27c., r. t., and for May-June-July, at 26½c., r. t. Copper for delivery in the second half of the year was offered at considerably lower terms against tenders of crude copper by buyers.

At midnight, Feb. 28, the New York, New Haven & Hartford R.R. put into effect a freight embargo on spelter, copper, lead and other material, owing to the overtaxed facilities of the road. This is likely to have some effect on the metal markets, but just what it will be remains to be determined.

The high prices for copper and spelter are causing a good deal of concern to the manufacturers who are engaged in the business of supplying wares other than ammunition. In taking orders for their products and contracting for metals to fill them, they take great chances on a declining market, cancellation of orders, etc. In some cases, where it is possible, they are causing their customers to buy the metals, thus practically putting their own manufacturing business on a toll basis.

The strike of the employees of the American Brass and Copper Co. at Ansonia, Conn., was settled Feb. 26 after a duration of 10 days. A 15% advance in wages, time and one-half for overtime, and half holiday Saturday, with full day's pay, has been conceded the strikers by the company.

Copper Sheets are now quoted at 35c. per lb. for hot rolled and 36c. for cold rolled. Copper wire is quoted at 29¼ @ 29¾ c. per lb. for large lots at mill. The demand for wire is reported very good.

Tin—This metal rose very sharply, owing to the large demand and a short supply. The deliveries into consumption in February were very large, amounting to 6,388 tons, whereof 5,000 tons were through Atlantic ports, and the remainder through Pacific ports. The quality of tin in stock is relatively small, and the quantity on the way to this country is not very large.

Arrivals at Liverpool in January of Bolivian bars and concentrates were equivalent to 866 tons tin. Nigerian receipts were equal to 273 tons tin.

Tin arrivals at Atlantic ports in February are reported at 3,907 gross tons. Deliveries from all ports are estimated at 6,380 tons.

Lead—This metal was the sensational feature of the last week. The A. S. & R. Co. maintained its price at 6.30c., New York, and did a large business at that figure, the reports in the trade papers that it was simply maintaining a nominal price, but not selling, being incorrect. In fact, this company, like other producers, was trying to protect its regular customers. In attempting to do that, orders from exporters, from speculators, from dealers and from unusual customers were refused. Such buyers were willing to pay up to 6.50c., New York, for lead, and independent producers booked orders in tonnages at that figure, at the same time supplying their regular customers at 6.30c. A similar policy was pursued by producers selling on the basis of St. Louis, but so far as we could learn, no lead was available at St. Louis in the latter part of the week at less than 6.35c., at which figure a large sale was made to a domestic manufacturer on Mar. 1. Even so, the St. Louis market was quoted at a price higher than what prevailed in New York, for the first time in very many months. A partial explanation of this is the ability to ship lead for export westward and southward from St. Louis, ocean freights being easier in those directions than they are from Atlantic ports. The situation existing in the lead market is very curious, the principal producers having been fighting the advance in the interest of their regular customers, and resisting a tendency toward a runaway market such as happened last June with disagreeable results.

Spelter—The business in this metal was only moderate in volume. France is no longer a buyer. However, some con-

DAILY PRICES OF METALS IN NEW YORK

Feb. Mar.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	St. Louis, Cts. per Lb.
24	4.7638	57	26½ @27	43	6.30 @6.35	6.22½ @6.27½	17.50 @20.25
25	4.7650	57	26½ @27	44	6.30 @6.40	6.22½ @6.30	17.50 @20.25
26	4.7650	56¾	26½ @27	44	6.30 @6.45	6.25 @6.30	17.50 @19.50
28	4.7656	56¾	26½ @27	50	6.30 @6.50	6.30 @6.40	17.50 @19.50
29	4.7650	56¾	26½ @27	48	6.30 @6.50	6.35 @6.50	17.50 @19.50
1	4.7650	56¾	26½ @26¾	50	6.30 @6.50	6.35 @6.50	17.50 @19.50

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Feb.-Mar.	Silver	Copper				Tin		Lead		Zinc	
		Standard		Electrolytic							
		Spot	3 Mos.	£ per Ton	Cts. per Lb.	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
24	27 1/16	103½	102	136	28.94	182	182¾	32¼	6.87	106	22.56
25	27 1/16	102½	100	136	28.95	184	184½	32⅜	6.84	108	22.99
26	27	.....	.....	.....	.....	.....	....	.....	.....	....	....
28	26 15/16	105	103	136	28.96	186¼	186¾	32⅞	7.00	109	23.20
29	26 15/16	105½	103½	136	28.95	188	188½	33⅛	7.06	110	23.41
1	26 15/16	101	99	136	28.95	188	188¼	32⅞	7.00	111	23.62

The above table gives the closing quotations on London Metal Exchange, All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21½c.

siderable sales for export to England were made. The bulk of the business transacted during the week was for April-May-June delivery. Spelter for prompt and early delivery was sold at a lower price than in the previous week, 19½c. being about the top of the market at the close. There were some considerable sales of spelter for delivery in the third quarter of 1916 at relatively low prices, 15@16c. On the whole, the spelter market exhibits a weaker tone.

The production of spelter in Japan in 1914 was only a few hundred tons. In 1915 it was about 9,000 tons. In 1916 it is expected to be about 15,000 tons. Japanese spelter is being exported to Russia and to Great Britain.

Imports at Baltimore for the week included 3,200 tons zinc concentrates from Port Pirie, Australia, and 22,325 bags zinc ore from Colombo.

Zinc Sheets are active with a good business forward. Prices are unchanged but firm. Current quotation is $25 per 100 lb., f.o.b. Peru, Ill., less 8% discount.

Gold, Silver and Platinum

NEW YORK—MAR. 1

Gold shipments from New York this week included $1,500,000 to Amsterdam and $1,000,000 to Cuba in new coin minted here for that country.

Gold production in the Transvaal in January was $16,276,943, showing a good increase over last year.

Platinum—No change is reported in the market. The supplies are still limited, and quotations are rather irregular. The larger dealers will not quote except to regular customers. Sales are reported at $85@95 per oz., for refined platinum.

Silver—The market continues steady. Latest advices from India are that very little interest is being taken at present in the London market—shipments to that quarter this year are about 6,000,000 oz. behind corresponding period of last year. Supplies to London are being taken for Continental purposes chiefly is the report under date of Feb. 16.

Other Metals

NEW YORK—Mar. 1

Antimony—The market is running along unchanged lines. Buying is only for actual needs and prices are strong. Ordinary brands—Chinese, etc.—are sold at 43½@44½c. per lb. for early delivery. A little has been done in futures, 40@42c. being asked for April-May delivery. Cookson's is still held at 57@60c. per lb. and is scarce.

Quicksilver—The market has been relieved a little by the arrival of some supplies and prices have eased off to some extent. New York quotations are $260 per flask of 75 lb. for large lots; $260@275 for smaller orders. San Francisco reports by telegraph $275@285 per flask. The London price appears to be pegged, and does not affect quotations here.

Aluminum—Demand is improving and prompt metal is again rather scarce. Prices have stiffened and as high as 60@62c. per lb. has been paid for No. 1 ingots for early delivery.

Nickel—The market is steady, with a good demand from domestic buyers and some inquiries for export. Quotations are unchanged at 45@50c. per lb. for ordinary forms, according to size and terms of order. For electrolytic metal 5c. per lb. more is charged.

Minor Metals—Current quotations for **Bismuth** are $4 per lb., New York.—**Cadmium** is quoted at 7s. per lb. in London; $1.50 per lb., New York.—**Chromium metal,** 75c. per lb., New York.—**Cobalt metal,** 97% pure, is sold at $1.25@1.50 per lb.—**Magnesium,** pure, has gone to a high price, $6 per lb. being asked.—**Selenium** varies from $2.50@3 per lb., New York, for large lots; $4.50@5 for retail quantities.

Zinc and Lead Ore Markets

PLATTEVILLE, WIS.—Feb. 26

The base price paid this week for 60% zinc ore was $115 per ton. The base price paid for 80% lead ore was $82 per ton.

SHIPMENTS WEEK ENDED FEB. 26

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	4,446,000	80,000	1,246,800
Year to date	32,422,000	575,700	7,236,260

Shipped during week to separating plants, 6,254,000 lb. zinc ore.

JOPLIN, MO.—Feb. 26

Blende, high price, $122.10; base per ton 60% zinc, premium ore, $120; medium grades, $115@110 and lower grades down to $100; calamine, per ton 40% zinc, $85@75; average selling price, all grades of zinc, $109.96 per ton. Lead, high price, $88.40; base per ton 80% metal contents, $87@88; average selling price, all grades of lead, $85.89 per ton.

SHIPMENTS WEEK ENDED FEB. 26

	Blende	Calamine	Lead	Values
Totals this week....	11,011,440	2,426,430	2,224,250	$832,530
Totals this year...	103,648,040	10,599,200	16,426,500	$6,858,470

Blende value, the week, $646,030; two months, $5,811,690.

Calamine value, the week, $90,990; two months, $384,970.

Lead value, the week, $95,510; two months, $661,810.

The water problem has been solved, and with another week of fair, dry weather the roads are all again in condition for use, though very rough for this district, except in the new district north of Miami, around what is known as Cardin and Picher. While the stocks were reduced to a minimum a week ago, refusal by many producers to accept the price offerings of the past two weeks, is again piling up a reserve, but it is still under 4,000 tons. Drill prospecting east from Picher is closing the gap of underslope toward Quapaw.

Iron Trade Review

PITTSBURGH—Feb. 29

All the signs, on the surface at least, are that the steel market is very strong, and growing still stronger. Mills insist that they are keeping their customers fairly well supplied with steel and that no one is greatly inconvenienced by not receiving steel needed, except in the case of Eastern and New England manufacturers, who may be shut off by railroad embargoes, which are as serious as they were in December. Buyers, however, seem to be fearful that they will not in future secure steel needed. There seems to be almost a panic among buyers, indeed, and if the steel situation should turn out a few months hence to be less strong than is now expected the explanation will probably be that buyers misrepresented their situation, claiming they were going to need more steel than proved to be the case. From a careful study of the situation there does not seem to be any other possibility of the steel situation weakening in six months or longer, than that of buyers being unduly anxious. The presumption is that their present anxiety is well founded.

Pig Iron—While the pig-iron market on the whole is somewhat more active, the local market is not engaged in the general buying movement predicted a week ago. Basic seems strong, but is not active, and there is only moderate buying in foundry iron. We quote: Bessemer, $20; basic, $18; forge, $18; No. 2 foundry, $18.50; malleable, $18@18.50, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Steel—The market is still inactive, the ordinary consumer being unable to pay prices that would be asked. We quote, as largely nominal, $35 for bessemer and $38 for openhearth billets or sheet bars, with rods established at $50 per ton.

FERROALLOYS

Ferromanganese—The regular contract price is $150, recently established, but some of the English producers are out of the market, and those that will contract at all can offer scarcely anything for third quarter, while even fourth quarter is well sold up. The domestic producers seem to be almost out of the market. Prompt material is scarce and when found commands $225@250 per ton.

The Lackawanna Steel Co. is about to start one of its furnaces at Cornwall, Penn., on ferromanganese, and will have some surplus for sale over its own needs.

Imports at Baltimore for the week included 1,037 tons ferromanganese from Liverpool.

Spiegeleisen has advanced and makers are now quoting $50 per ton at Pittsburgh for spot, with $45 per ton for contracts running over last half.

COKE

Coke production in the Connellsville region for the week is reported by the "Courier" at 418,287 short tons; shipments, 394,180 tons. Shipments of Greensburg and Upper Connellsville districts, 43,343 tons. Shipments were kept down by car shortage, and there is also some complaint of scarcity of labor.

Connellsville—Car shortages continue, interfering with shipments and even production. The furnaces do not seem to be as short of coke as would be expected in the circumstances, and there is little buying in the prompt market. Last Saturday, after two weeks of a scant car supply, a lot of 20 cars for spot shipment brought $3.75, but this is somewhat exceptional. Foundry coke is rather slow at $3.75@4.25 for spot. Contract quotations are purely nominal.

Assessments

Company	Delinq.	Sale	Amt.
Adventure, Mich	Mar. 20	.....	$0.50
Adventure, Mich	July 20	.....	0.50
Alta-Germanic, Utah	Feb. 8	Feb. 28	0.005
Basalt, Nev	Mar. 8	Apr. 6	0.003
Belmont, Ida	Feb. 15	Mar. 11	0.003
Boston Development	Feb. 17	Mar. 8	0.05
Cash Boy, Nev	Feb. 16	Mar. 20	0.01
Columbia Ex., Utah	Feb. 23	Mar. 14	0.025
Con. Virginia, Nev	Mar. 14	Apr. 4	0.05
Emerald, Utah	Feb. 15	Mar. 11	0.00½
Emerald, Utah	Mar. 15	Apr. 11	0.00½
Empire M. & D., Ida., (post.)	.....	Mar. 10	0.005
Exchequer G. & S., Nev	Feb. 16	Mar. 8	0.03
Federal Ely, Nev	Mar. 1	Apr. 3	0.005
Federal Ely, Nev	Apr. 1	May 1	0.005
Federal Ely, Nev	May 1	June 4	0.005
Four Timbers, Ida	Feb. 24	Mar. 24	0.002
Great Copper King, Utah	Feb. 14	Mar. 11	0.001
Imperial, Ida	Feb. 19	Mar. 20	0.003
Index, Ida	Feb. 6	Mar. 6	0.0025
Jacket-Crown Pt.-Belc., Nev.	Feb. 18	Mar. 10	0.06
Laclede, Ida	Feb. 4	Feb. 28	0.003
Lucky Deposit, Utah	Feb. 11	Mar. 13	0.005
Monarch Pitts., Nev	Feb. 18	Mar. 20	0.01
Nevada-Douglas, Nev	Feb. 10	Mar. 10	0.10
New Quincy, Utah	Mar. 11	Mar. 30	0.01
Park Gold, Utah	Apr. 1	Apr. 20	0.001
Queen Bess, Utah	Feb. 20	Mar. 20	0.005
Revenue Cons., Utah	Feb. 5	Mar. 3	0.01
Rio Grande Grubstake, Utah	Dec. 25	Feb. 29	0.006
Rob Roy, Ida	Feb. 5	Mar. 5	0.002
Sandstorm Kendall, Nev	Feb. 21	Mar. 27	0.01
Santaquin King, Utah	Feb. 8	Mar. 8	0.00125
Scorpion, Nev	Feb. 21	Mar. 14	0.01
Silver Moon, Ida	Feb. 26	Mar. 22	0.005
Silver Mountain, Ida	Feb. 17	Mar. 17	0.002
Silver Pick Con., Nev	Feb. 28	Apr. 3	0.01
Slavonian, Ida	Feb. 1	Feb. 29	0.001
Snowshoe, Ida	Feb. 15	Mar. 15	0.005
Summit Ex., Utah	Mar. 15	May 1	0.01
Tar Baby, Utah	Dec. 31	Feb. 28	0.005
Tintic Milling, Utah	Mar. 14	Apr. 3	0.03
Tintic Standard, Utah	Mar. 15	Apr. 10	0.005
Tyler M. & M., Ida	Jan. 28	Feb. 28	0.001
Utah-United, Utah	Mar. 10	Mar. 30	0.01
Uvada, Nev	Feb. 21	Mar. 20	0.02
West Toledo, Utah	Mar. 6	.....	0.01

Stock Quotations

COLO. SPRINGS	Feb. 29	SALT LAKE	Feb. 29
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.05	Beck Tunnel	.24½
Cripple Cr'k Con.	.008	Black Jack	.17½
Dante	.02½	Colorado Mining	.25
Doctor Jack Pot	.10½	Crown Point	.07¼
Elkton Con	.30½	Daly-Judge	8.00
El Paso	.82	Emma Cop	.69
Findlay	.04½	Gold Chain	.30
Gold Dollar	.03	Grand Central	.65
Gold Sovereign	.04½	Iron Blossom	1.60
Golden Cycle	2.05	Lower Mammoth	.08
Isabella	.19½	May Day	.18½
Jack Pot	.06½	Opohongo	.02
Jerry Johnson	.05½	Prince Con	1.05
Lexington	.005	Seven Troughs	.01½
Mary McKinney	.45½	Silver King Coal'n	3.35
Pharmacist	.01	Silver King Con	2.47½
Portland	1.75	Sioux Con	.13½
Raven B. H.	.02	Uncle Sam	.11
Vindicator	2.30	Yankee	.35½

SAN FRANCISCO	Feb. 29		
Alta	.05	Belmont	4.25
Andes	.06	Jim Butler	.95
Best & Belcher	.02	Lone Star	.02
Caledonia	.31	MacNamara	.05
Challenge Con	‡.05	Midway	.15
Chollar	‡.02	Mont.-Tonopah	.27
Confidence	‡.15	North Star	.15
Con. Virginia	.08	Rescue Eula	.10
Gould & Curry	‡.01	West End Con	.73
Hale & Norcross	.04	Atlanta	.17
Jacket-Cr. Pt	.11	Blue Bell	.02
Julia	‡.01	Booth	.38
Mexican	.19	C.O.D. Con	.03
Occidental	.75	Comb. Frac	.07
Ophir	.19	D'field Daisy	.05
Overman	.04	Jumbo Extension	1.05
Savage	.04	Pitts.-Silver Peak	.07
Seg Belcher	.02	Round Mountain	.58
Sierra Nevada	.33	Sandstorm Kendall	‡.04
Union Con	.44	Silver Pick	.05
Utah Con	.02	Central Eureka	.14

TORONTO	Feb. 29		
Bailey	‡.05½	Dome Exten	.27
Chambers Ferland	.20	Dome Lake	.24
Coniagas	4.25	Foley O'Brien	.50
La Rose	.60	Hollinger	24.75
Peterson Lake	‡.24½	Imperial	‡.03½
Right of Way	‡.05½	Jupiter	.21½
Seneca Superior	.45	McIntyre	.87
T. & Hudson Bay	23.00	Porcu. Crown	.75
Temiskaming	.54	Preston E. D.	‡.03½
Trethewey	.14	Vipond	.55
Wettlaufer-Lor	.07	West Dome	.20

LONDON	Feb. 15		
Alaska Treadwell	£6 17s 6d	Mexico Mines	£3 17s 6d
Burma Corp	1 13 9	Nechi, pfd	0 14 0
Cam & Motor	0 12 0	Oroville	0 13 9
Camp Bird	0 7 0	Santa Gert'dis	‡0 10 0
El Oro	0 8 0	Tomboy	1 1 6
Esperanza	‡0 10 3	Tough Oakes	0 11 9

N. Y. EXCH.	Feb. 29	BOSTON EXCH	Feb. 29
Name of Comp.	Clg.	Name of Comp.	Bid
Alaska Gold M	21	Adventure	2½
Alaska Juneau	9	Ahmeek	397½
Am.Sm.&Ref.,com	97½	Algomah	1
Am. Sm. & Ref., pf.	111½	Allouez	70½
Am. Sm. Sec., pf. A	92	Ariz. Com., ctfs	8½
Am. Sm. Sec., pf. B	86½	Bonanza	.35
Am. Zinc	77½	Butte Alex. Scott	9½
Anaconda	85½	Butte-Balaklava	4
Batopilas Min	2	Calumet & Ariz	73½
Bethlehem Steel	460	Calumet & Hecla	562
Bethlehem Steel, pf.	125	Centennial	16
Butte & Superior	89½	Copper Range	62½
Chile Cop	22½	Daly West	2½
Chino	55½	East Butte	12½
Colo. Fuel & Iron	41	Franklin	9
Crucible Steel	73½	Granby	88½
Dome Mines	24	Hancock	16
Federal M. & S.	‡27	Hedley	‡25½
Federal M. & S., pf.	50½	Helvetia	.40
Great Nor., ore., ctf.	51½	Indiana	‡5½
Greene Cananea	45½	Island Cr'k, com.	45½
Guggen. Exp	21	Island Cr'k, pfd	89½
Homestake	130	Isle Royale	27½
Inspiration Con	44½	Keweenaw	3
International Nickel	45½	Lake	16½
Kennecott	53½	La Salle	4½
Lackawanna Steel	74½	Mason Valley	2½
Miami Copper	35½	Mass	13½
Nat'l Lead, com	66	Mayflower	3½
National Lead, pf	113	Michigan	1½
Nev. Consol	16½	Mohawk	91
Ontario Min	6½	New Arcadian	8½
Quicksilver	4½	New Idria	18½
Quicksilver, pf	5½	North Butte	29½
Itay Con	24½	North Lake	1½
Republic I&S, com.	49½	Ojibway	1½
Republic I&S, pf	109	Old Colony	3
Sloss-Sheffield	54	Old Dominion	68½
Sloss-Sheffield, pf	90	Osceola	92½
Tennessee Copper	55	Quincy	91½
Utah Copper	83½	St. Mary's M. L.	68
U. S. Steel, com	82½	Santa Fe	3
U. S. Steel, pf	116½	Shannon	10½
Va. Iron C. & C	45	Shattuck-Ariz	37

N. Y. CURB	Feb. 29		
Alta Con	.21	So. Lake	6½
Beaver Con	.36	So. Utah	.25
Big Four	‡.04	Superior	19
Buffalo Mines	.90	Superior & Bost	3½
Butte & N. Y.	3½	Tamarack	48½
Butte C. & Z.	7½	Trinity	8½
Can. Cop. Corpn	1 11/16	Tuolumne	.19
Cashboy	.04	U. S. Smelting	60½
Cerro de Pasco	37½	U. S. Smelt'g, pf.	50½
Con. Ariz. Sm.	1½	Utah Apex	4½
Con. Copperminers	2	Utah Con	14
Con. Nev.-Utah	⅛	Victoria	3 13/16
Dia. Black B.	.02	Winona	4
First Nat. Cop	5⅛	Wolverine	64
Florence	.46	Wyandot	1½
Goldfield Con	.90		
Goldfield Merger	.15		
Hecla Min	4½		
Howe Sound	5½		
Kerr Lake	4		
Magma	17½		
Majestic	1/16		
McKinley-Dar-Sa	.44		
Mines of Am	2⅛		
Mother Lode	.20		
Nevada Hills	.21		
New Utah Bingham	4		
Nipissing Mines	6⅛		
Oro	.04		
Ray Hercules	3		
Rochester Mines	.62		
St. Joseph Lead	15		
Stand'd Oil of N.J.	507		
Standard S. L.	1½		
Stewart	3/32		
Success	.90		
Tonopah	6½		
Tonopah Ex	4½		
Tonopah Merger	.62		
Tribullion	⅛		
White Knob, pf	1½		
Yukon Gold	2½		

BOSTON CURB	Feb. 29		
Bingham Mines	9	Mexican Metals	.47
Boston Ely	.40	Mojave Tungsten	5⅛
Butte & Lon'n Dev.	.68	Nat. Zinc & Lead	2½
Calaveras	3	Nevada-Douglas	.85
Calumet-Corbin	.04	New Baltic	3
Chief Con	1 7/16	New Cornelia	11½
Cortez	.60	Ohio Copper	.15
Crown Reserve	.40	Oneco	1½
Davis-Daly	1½	Raven Copper	.18
Eagle & Blue Bell	1 5/16	Rex Cons	.17
Houghton Copper	2½	Rilla	1½
Iron Cap Cop., pf	7	United Verde Ext	13½
Mexican Metals	.47	Utah Metal	9½

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1914	1915	1916	1914	1915	1916
January	56.572	48.855	56.775	26.553	22.731	26.953
February	57.506	48.477	56.755	26.573	22.753	26.975
March	58.067	50.241	.....	26.788	23.708	.....
April	58.519	50.250	.....	26.958	23 709	.....
May	58.175	49.915	.....	26.704	23.570	.....
June	56.471	49.034	.....	25.948	23.267	.....
July	54.678	47.519	.....	25.219	22.597	.....
August	54.344	47.163	.....	25.979	22.780	.....
September	53.290	48.680	.....	24.260	23.591	.....
October	50.654	49.385	.....	23.199	23.925	.....
November	49.082	51.714	.....	22.703	25.094	.....
December	49.375	54.971	.....	22.900	26.373	.....
Year	54.811	49.604	.....	27.314	23.675	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York		London			
	Electrolytic		Standard		Electrolytic	
	1915	1916	1915	1916	1915	1916
January	13.641	24.008	60.756	88.083	65.719	116.17
February	14.394	26.440	63.494	102.67	*	133.17
March	14.787	.....	66.152	.....	*	.....
April	16.811	.....	75.096	.....	*	.....
May	18.506	.....	77.600	.....	*	.....
June	19.477	.....	82.574	.....	95.333	.....
July	18.796	.....	76.011	.....	91.409	.....
August	16.941	.....	68.673	.....	82.333	.....
September	17.592	.....	68.915	.....	85.250	.....
October	17.686	.....	72.601	.....	88.000	.....
November	18.627	.....	77.744	.....	93.273	.....
December	20.133	.....	80.773	.....	100.43	.....
Year	17.275	.....	72.532	.....	.....	.....

TIN

Month	New York		London	
	1915	1916	1915	1916
January	34.260	41.825	156.550	175.548
February	37.415	42.717	176.925	181.107
March	48.426	.....	180.141	.....
April	47.884	.....	166.225	.....
May	38.790	.....	162.675	.....
June	40.288	.....	167.636	.....
July	37.423	.....	167.080	.....
August	34.389	.....	151.440	.....
September	33.125	.....	152.625	.....
October	33.080	.....	151.554	.....
November	39.224	.....	167.670	.....
December	38.779	.....	167.000	.....
Av. year	38.500	.....	163.960	.....

LEAD

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
January	3.729	5.921	3.548	5.826	18.606	31.167
February	3.827	6.246	3.718	6.164	19.122	31.988
March	4.053	.....	3.997	.....	21.883	.....
April	4.221	.....	4.142	.....	21.094	.....
May	4.274	.....	4.182	.....	20.347	.....
June	5.932	.....	5.836	.....	25.170	.....
July	5.659	.....	5.531	.....	24.611	.....
August	4.656	.....	4.520	.....	21.946	.....
September	4.610	.....	4.490	.....	23.151	.....
October	4.600	.....	4.499	.....	23.994	.....
November	5.155	.....	5.078	.....	26.278	.....
December	5.355	.....	5.266	.....	28.807	.....
Year	4.628	.....	4.587	.....	22.917	.....

SPELTER

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
Jan	6.386	16.915	6.211	16.745	30.844	89.810
Feb	8.436	18.420	8.255	18.260	39.819	97.762
Mar	8.541	.....	8.360	.....	44.141	.....
April	10.012	.....	9.837	.....	49.888	.....
May	14.781	.....	14.610	.....	68.100	.....
June	21.208	.....	21.038	.....	100.614	.....
July	19.026	.....	18.856	.....	97.250	.....
Aug	12.781	.....	12.611	.....	67.786	.....
Sept	13.440	.....	13.270	.....	67.841	.....
Oct	12.800	.....	12.596	.....	66.536	.....
Nov	15.962	.....	15.792	.....	88.409	.....
Dec	15.391	.....	15.221	.....	89.400	.....
Year	13.230	.....	13.054	.....	67.553	.....

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1915	1916	1915	1916	1915	1916
January	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February	14.55	21.33	13.45	18.95	13.90	19.51
March	14.55	.....	13.45	.....	13.95	.....
April	14.55	.....	13.45	.....	13.95	.....
May	14.64	.....	13.60	.....	13.83	.....
June	14.70	.....	13.67	.....	13.77	.....
July	14.94	.....	13.91	.....	13.68	.....
August	16.01	.....	15.31	.....	14.75	.....
September	16.86	.....	15.95	.....	15.70	.....
October	16.95	.....	15.96	.....	15.80	.....
November	18.26	.....	17.30	.....	17.20	.....
December	19.95	.....	18.95	.....	18.95	.....
Year	$14.89	.....	$13.76	.....	$13.89	.....

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